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163

INDIAN JOURNAL OF POWER & RIVER VALLEY DEVELOPMENT

ORISSA IRRIGATION & POWER DEVELOPMENT NUMBER

VOL. VII. NO. 1 JANUARY 1957 RUPEES TWO

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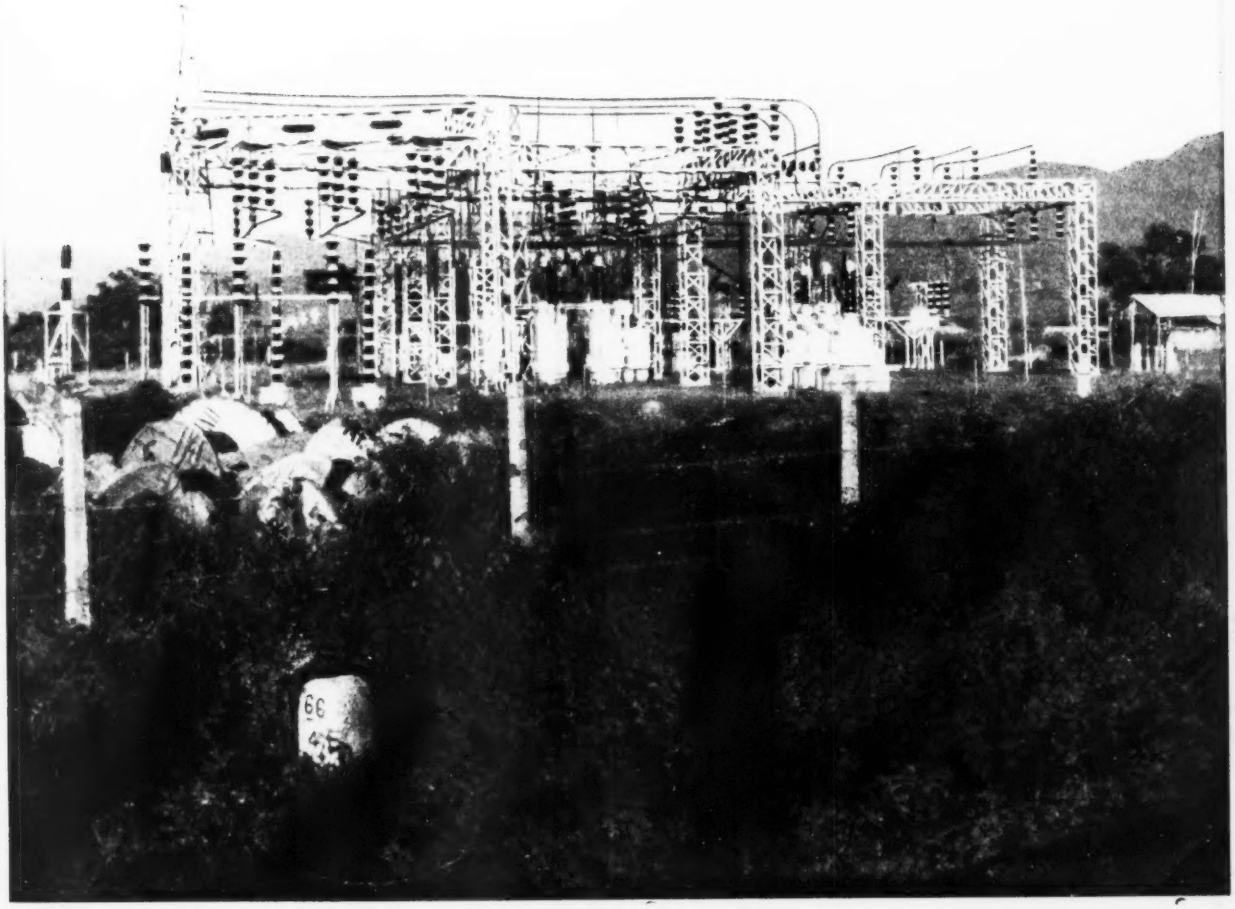
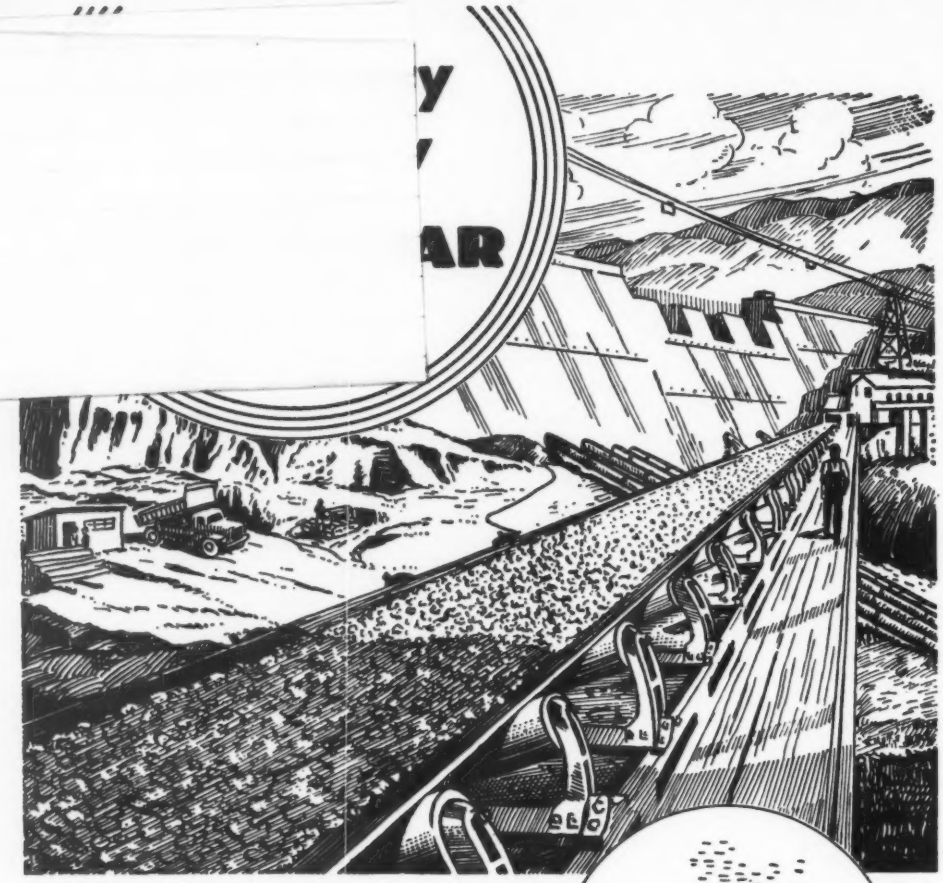


132 KV SUBSTATION AT RAYAGADA, ORISSA



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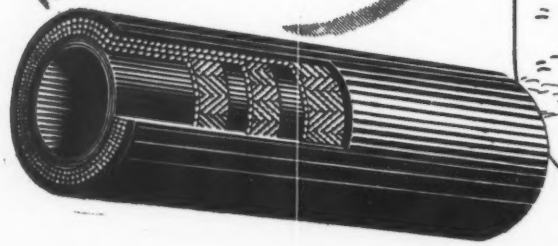

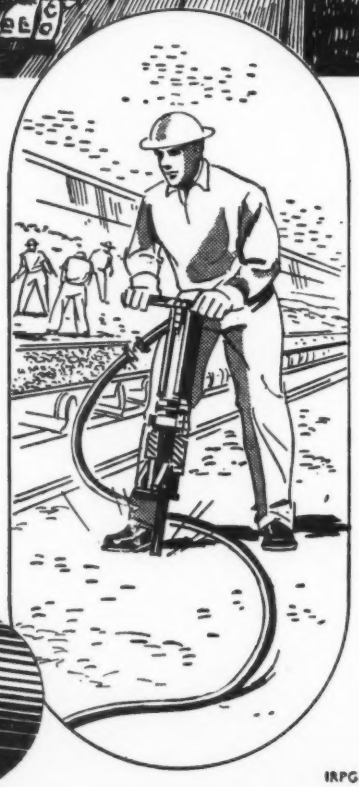

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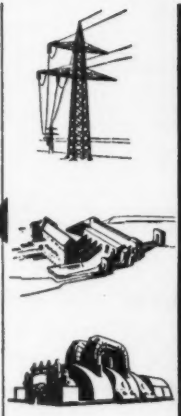

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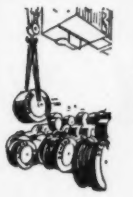

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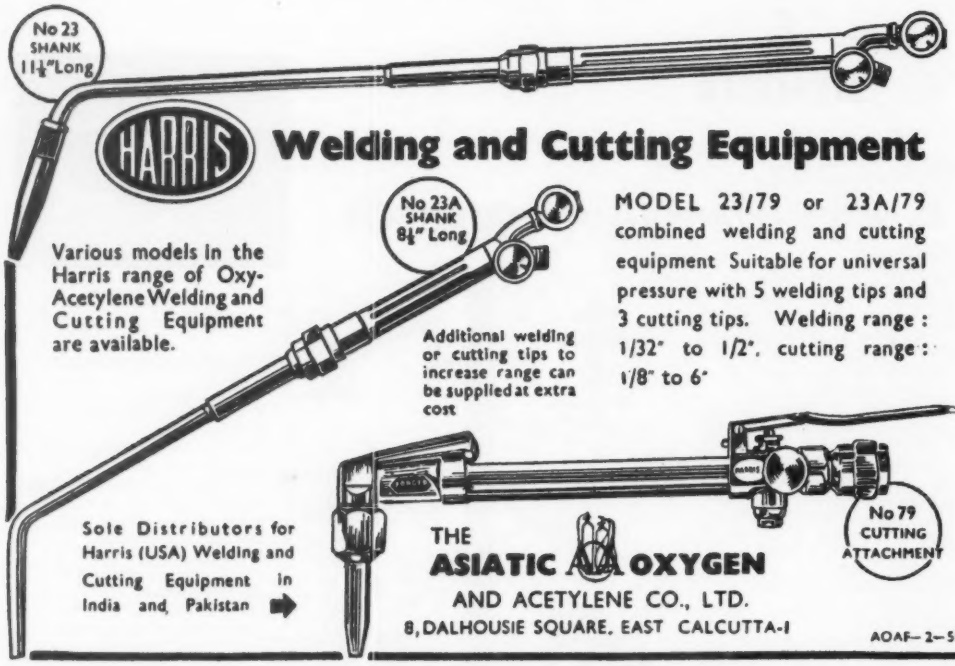
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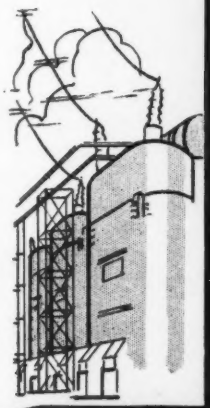

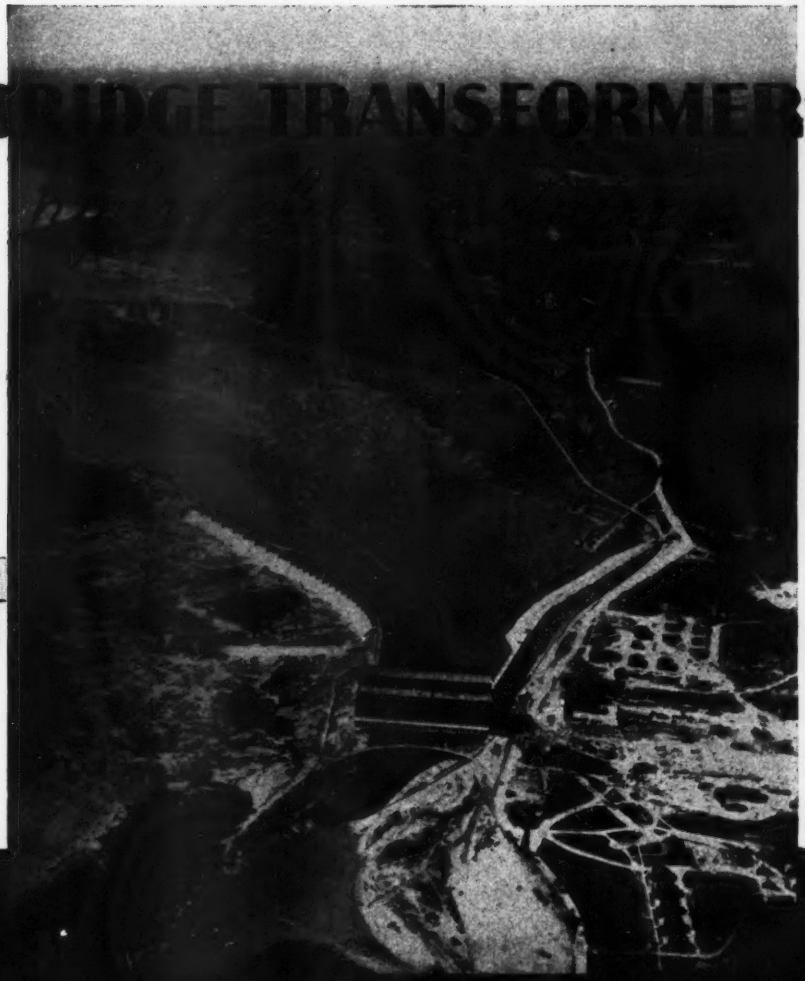

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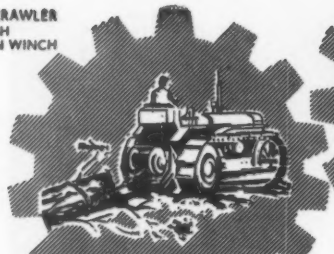

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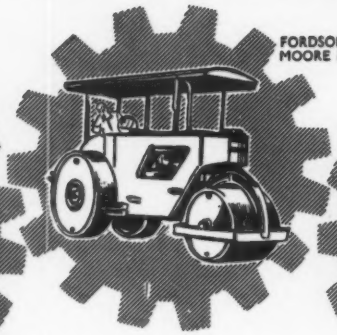

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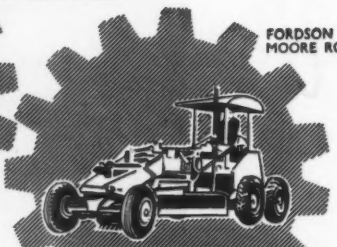

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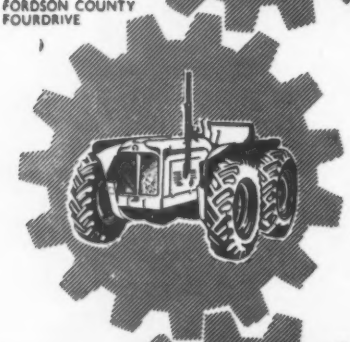

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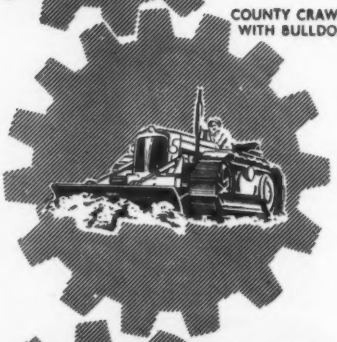

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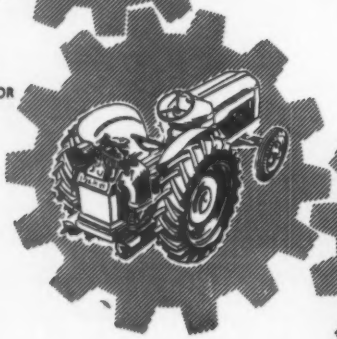

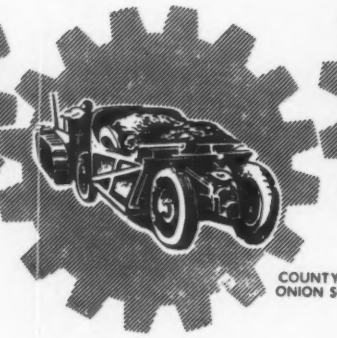

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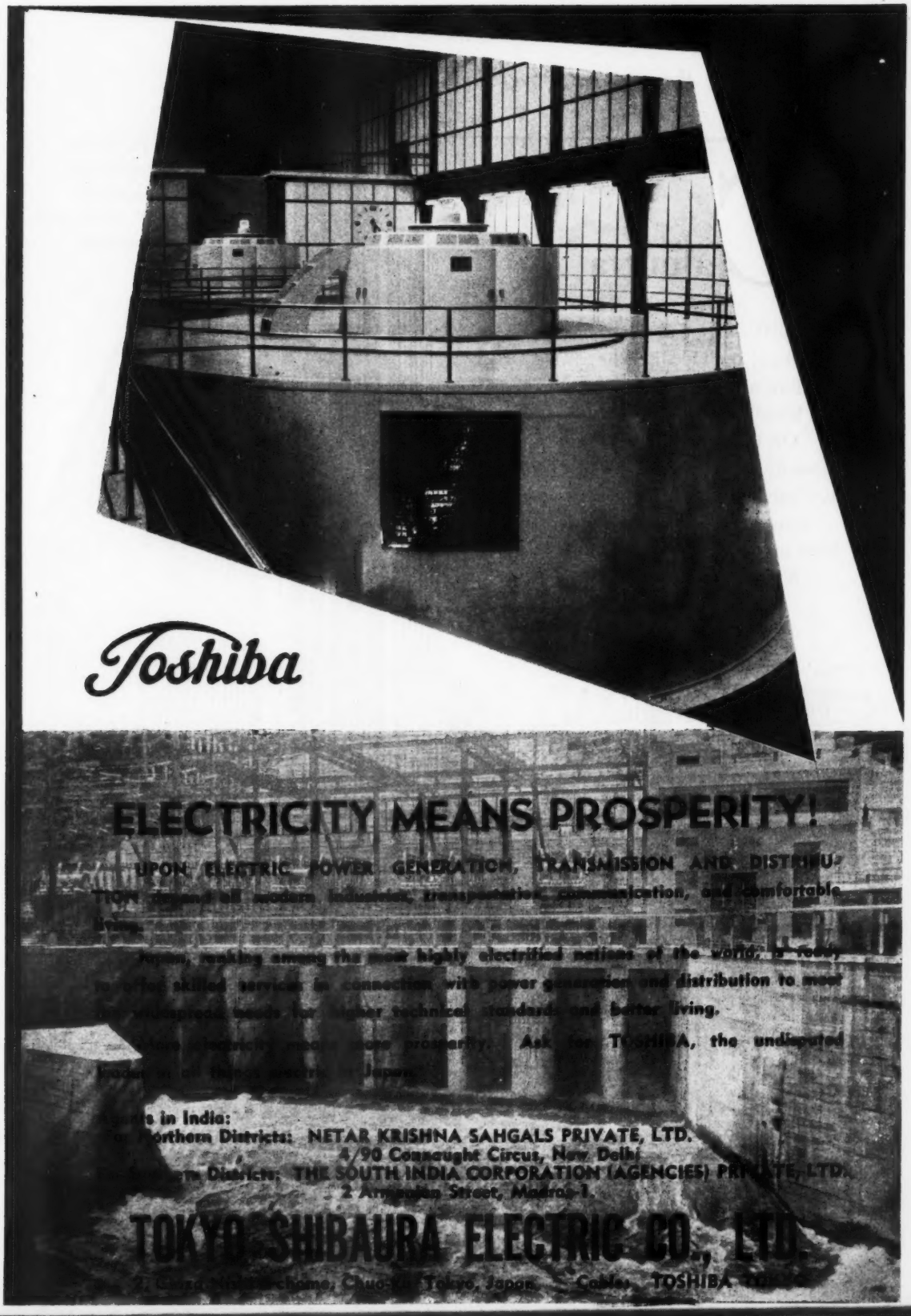
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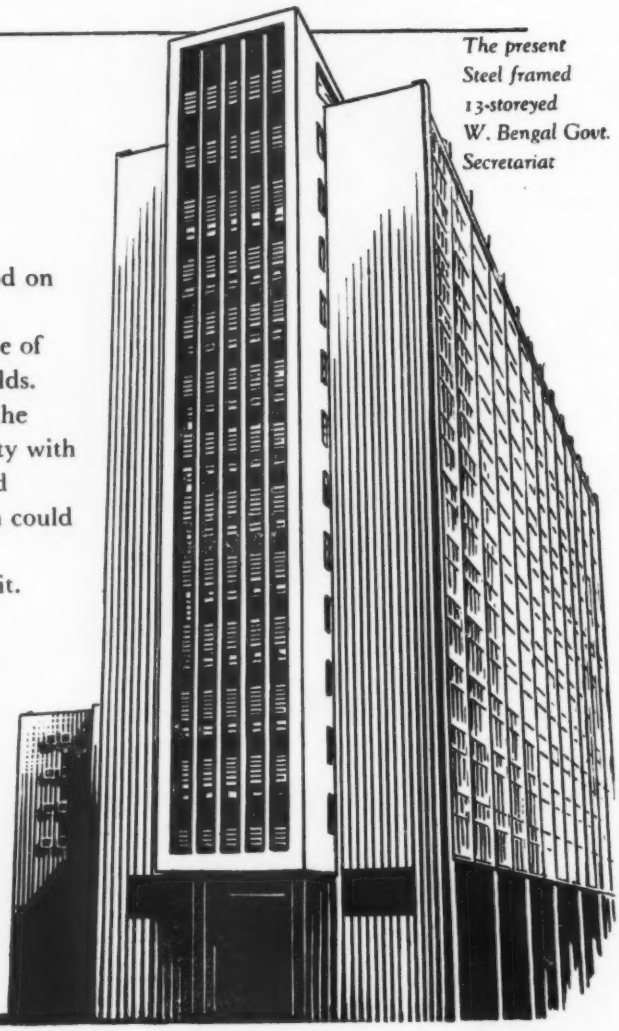

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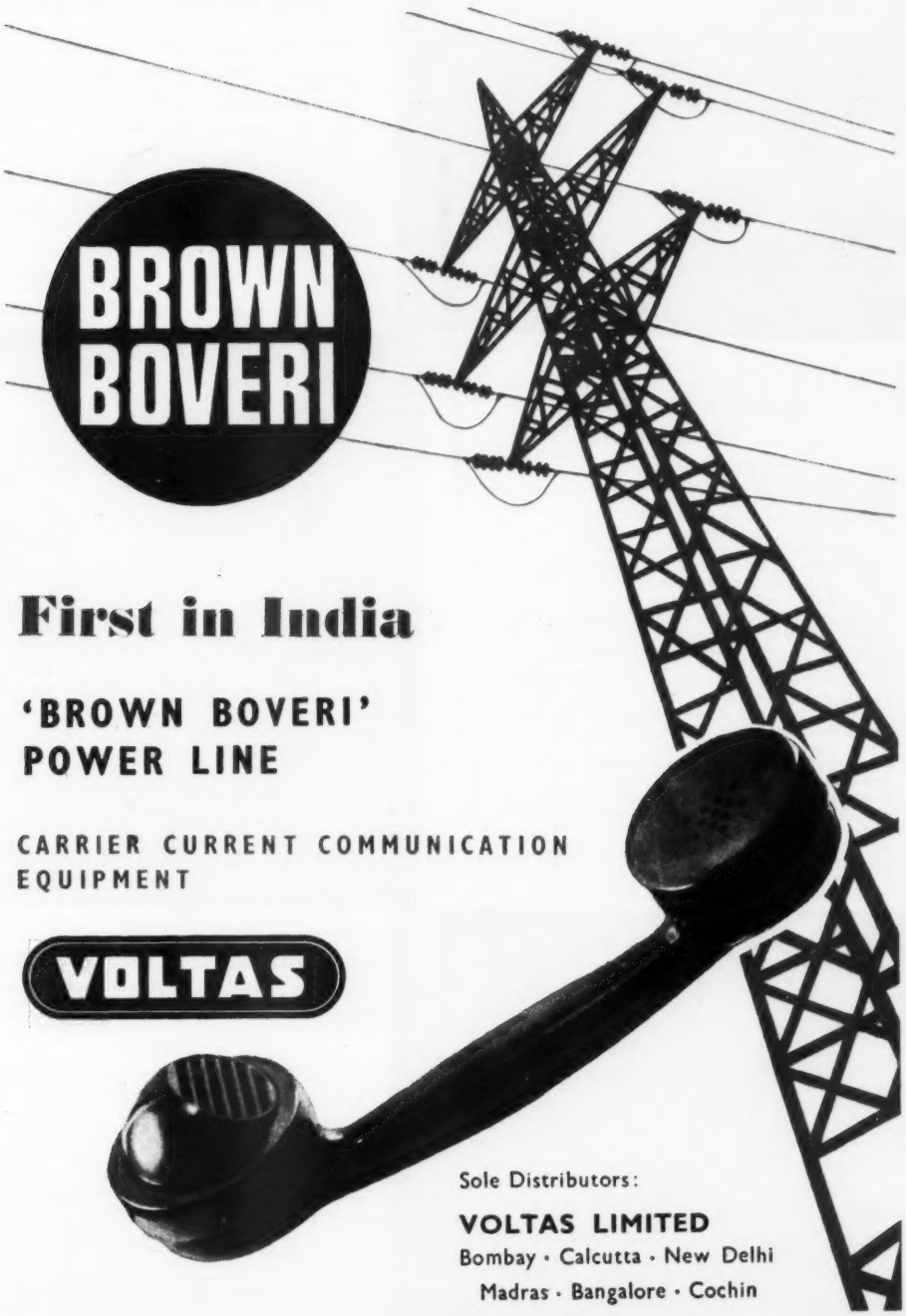

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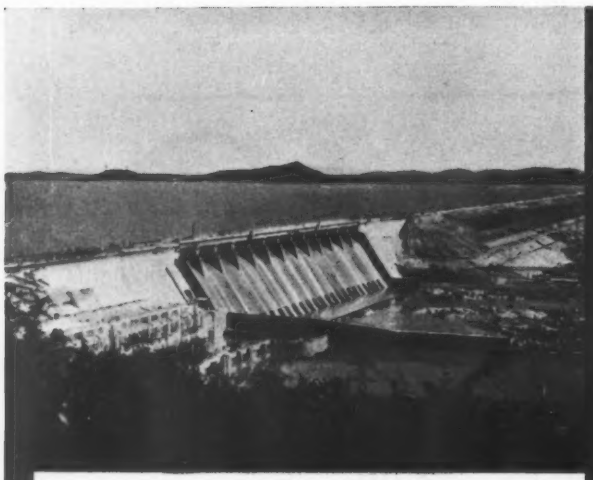

HIRAKUD DAM POWER PROJECT

The inauguration of the Hirakud Dam Power Project by Pandit Nehru, Prime Minister of India, opens a new phase in the economic life of the country. Harnessing the Mahanadi river, the Hirakud Dam Project will bring power to the millions. **A. E. I.** are proud of the part they have played in the supply and erection of electrical equipment.

LIST OF EQUIPMENTS SUPPLIED TO THE HIRAKUD DAM PROJECT

By **A. E. I.**

Two 42 MVA, 11/132 kV transformers.
Two 27 MVA, 11/132 kV transformers.
Two 12.5MVA 132/66 kV transformers.
Two 2000 kVA 66/11 kV transformers.
Two 600 kVA 11 kV/420 volts transformers.
Four 200 kVA 11 kV/420 volts transformers.
14 Nos. 132 kV 2500 MVA oil circuit breakers.
6 Nos. 66 kV 500 MVA oil circuit breakers.
34 Nos. 132 kV 400 amps isolating switches.
16 Nos. 66 kV 400 amps isolating switches.
36 Nos. 132 kV single phase lightning arresters.
24 Nos. 66 kV single phase lightning arresters.
One 7 panel 11 kV 75 MVA switchboard.
14 panel 132 kV control & relay boards with 4 control desks and synchronising equipment.
6 panel 66 kV control and relay boards.
4 Nos. neutral earthing cubicles.
4 Nos. surge protection cubicles.
Four 420 volts unit auxiliary switchboards.
One 420 volts station service switchboard.
Two 420 volts switchyard auxiliary switchboards.
One 230 volts 353 amp-hour D. C. battery and battery control board.
Control cables.
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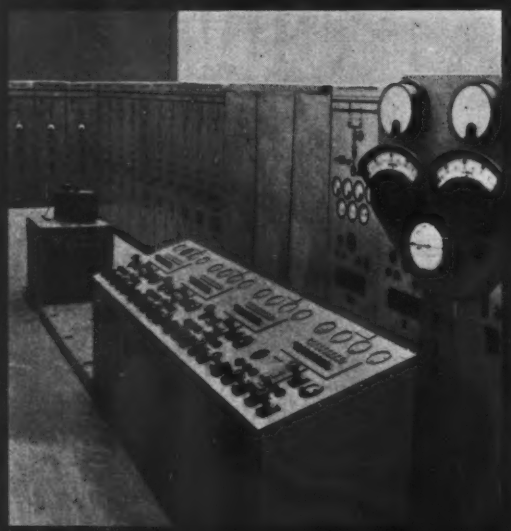

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Transformers and Switchgear at Hirakud Power Station

by

ASSOCIATED ELECTRICAL INDUSTRIES (INDIA) PRIVATE LTD.

Associated Electrical Industries (India) Private Ltd. received the order for the supply and delivery of the Power Transformers and the entire switchgear equipments for the Hirakud Power Station which recently went into commission. They also provided trained personnel for supervising the erection and commissioning of all the equipments supplied by them thereby enabling the Project Authorities to have their staff associated with and trained in the erection and maintenance of these equipments.

The Station now has four generating units, two of 42,000 kVA and two of 27,000 kVA capacity. The generation of electricity from these units is at 11,000 volts and the unit principle, whereby each generating unit connected to its step-up transformer is directly connected to the 132 kV busbars through its circuit breaker is adopted.

The outdoor switchyard had to be laid out for the accommodation of four incoming feeders, seven outgoing feeders, two feeders to supply the 66 kV system, and a bus coupler in addition to three future incoming feeders, all at 132 kV. Two 12,500 kVA transformers step-down the voltage from 132 kV to 66 kV and feed the 66 kV system. There are three outgoing 66 kV feeders, and two feeders for 66/11 kV step-down transformers in the 66 kV switchyard.

Owing to the limited site space available, the 132 kV double busbar layout had to be of the high level type but it was found possible to provide a low level layout for the 66 kV mesh system.

The main step-up transformers are of the standard 3 phase units, oil immersed, 11,000/132,000 volts ratio and are provided with forced oil circulation with water cooling in an oil/water heat exchanger. The two 42 mVA transformers are of BTH manufacture and the two 27 mVA transformers are of M-V manufacture. These transformers together with 200 kVA unit transformers and 600 kVA station transformers are located on the draught tube deck on the down-stream side of the generating units. There are four 200 kVA 11,000/420 volts unit transformers, one each for the generating units, which will enable low tension supply for the generator and turbine auxiliaries to be obtained from its own output. These unit transformers are provided with on-load tap changing gear. There are two 600 kVA 11,000/420 volts station transformers deriving supply from an 11 kV switchboard, and supplying power to the general station auxiliaries. The 200 kVA and 600 kVA transformers are of M-V manufacture.

There are four power transformers at the switchyard, two of 12,500 kVA, 3-phase, oil immersed, 132,000/66,000 volts ratio, provided with forced oil circulation, with water cooling in an oil/water heat exchanger, and two of 2,000 kVA, 3-phase, oil immersed, 66,000/11,000 volts ratio, with natural cooling. The 12,500 kVA transformers which are of M-V manufacture, are provided with on-load tap changing gear. The 2,000 kVA transformers are also of M-V manufacture, and provide the supply to an 8 panel BTH type QA.341, 75 mVA, 11 kV switchboard, which caters for local loads. One leg of one 132 kV winding of each of the 42 mVA, 27 mVA and 12.5 mVA transformers has been impulse tested for 650 kV withstand at the manufacturers works.

All the fourteen 132 kV circuit breakers are of the M-V type HG6CM triple pole, bulk oil pattern rated at 2500 mVA. These breakers are designed for a high operating speed and tests have shown that a total break time of 3 cycles can be achieved at any duty within their range. These breakers are provided with multi-break cross jet contacts, with resistance voltage grading. Each breaker consists of three separate fabricated steel tanks, coupled together by contact operating rods. The breakers are fitted with pneumatic closing machanism. The bushings of the 132 kV circuit breakers are of the oil filled condenser type and accommodate also the current transformers for metering and protection.

The compressed air for the pneumatic operating mechanism is provided by duplicate air compressors. A ring main is provided, the air being piped to a local air receiver at each 132 kV breaker. This local storage, combined with the main duplicate storage tanks, ensures continuity of service.

There are six 66 kV oil circuit breakers. These are of the M-V, type LG3C bulk oil breakers, rated at 500 mVA, and fitted with solenoid closing mechanism. Each phase is housed in a separate specially shaped tank and these are mounted on structural steel framework providing for rapid and easy installation.

The 132 kV and 66 kV isolating switches are manually operated from ground level and are of the triple pole, 3-post, centre post rotating type, rated at 400 amps. There are thirtyfive isolating switches for the 132 kV and twentyone isolating switches for the 66 kV. These were all manufactured by Associated. Electrical Industries Manufacturing Co. Private Ltd. at Calcutta.

The 132 kV double busbars, which comprise two hollow cored copper conductors per phase are more than 40 feet above ground level and are held by tension insulators, at each end, and supported by post insulators carried on longitudinal girders at every 34 ft. span. The massive supporting galvanised steelwork of the Portal type comprising columns and girders of 3 ft. $\times$ 3 ft. box type lattice structure with angle sections, was entirely designed and fabricated in India.

The indoor equipment at the control room comprises of a 17 panel corridor type control and relay board controlling the generating units and the outgoing 132 kV feeders. Four control desks are also provided for the present generating units. There is a 5 panel, 66 kV control and relay panel. The complete equipment at the control room is of M-V manufacture.

The indoor equipments supplied also include two unit auxiliary 420 volts switchboard of BTH manufacture, and two unit auxiliary 420 volts switchboard of M-V manufacture. There is a general station service 420 volt switchboard partly of M-V and partly of BTH manufacture. All the 420 volt switchboards are a combination of switch fuse units and air break circuit breaker equipments of 25 mVA rupturing capacity.

The power station is also provided with a 353 ampere hour 230 volts D.C. lead acid battery. A quick charging and a trickle charging equipment and also a D.C. distribution board have been provided.

The complete protective gear equipment at this station is provided by M-V. The generator transformer is provided with combined, biased differential protection and over-current protection. The generator itself is provided with rotor earth fault protection, negative phase sequence protection, earth fault protection, over-voltage and over-frequency protection. High speed contraphase carrier current protection with back-up over-current and earth fault protection is provided for the important 132 kV outgoing feeders. The 66 kV outgoing feeders are provided with high speed impedance protection. A bus zone protection for the 132 kV busbars is also provided

The control cables required for this power station running over 40,000 yards have been supplied by the Edison Swan Electric Co. These are of the varnished cambric insulated lead sheathed 660 volt grade cables. Another feature of this power station is the connection of the generator to its step-up transformer by bare copper straps suitably supported and enclosed in woven wire aluminium screens.

Associated Electrical Industries (India) Private Ltd. are proud of the part, they and their associated companies have played in the supply and erection of electrical equipment for the Hirakud Dam Power Station.

The ENGLISH ELECTRIC Company Limited, has been awarded contracts for the first five 200 MW steam turbo-alternator sets to be ordered and produced in the United Kingdom.

The Company is the first manufacturer to have on order at the same time units of all the standard ratings of the Central Electricity Authority, U.K., namely:—

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100 MW,	1500 p.s.i.g.,	1050° F.	straight cycle
60 MW,	1500 p.s.i.g.,	1050° F.	straight cycle
60 MW,	900 p.s.i.g.,	900° F.	straight cycle
30 MW,	600 p.s.i.g.,	850° F.	straight cycle

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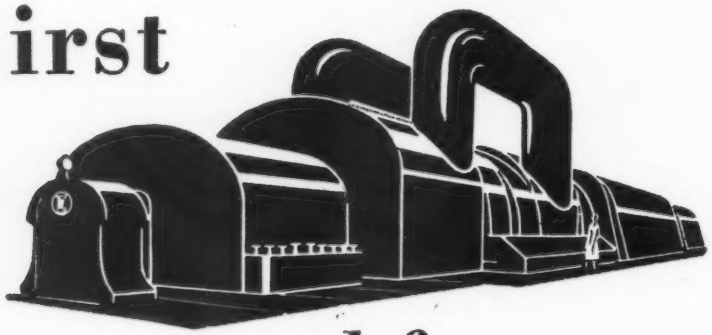

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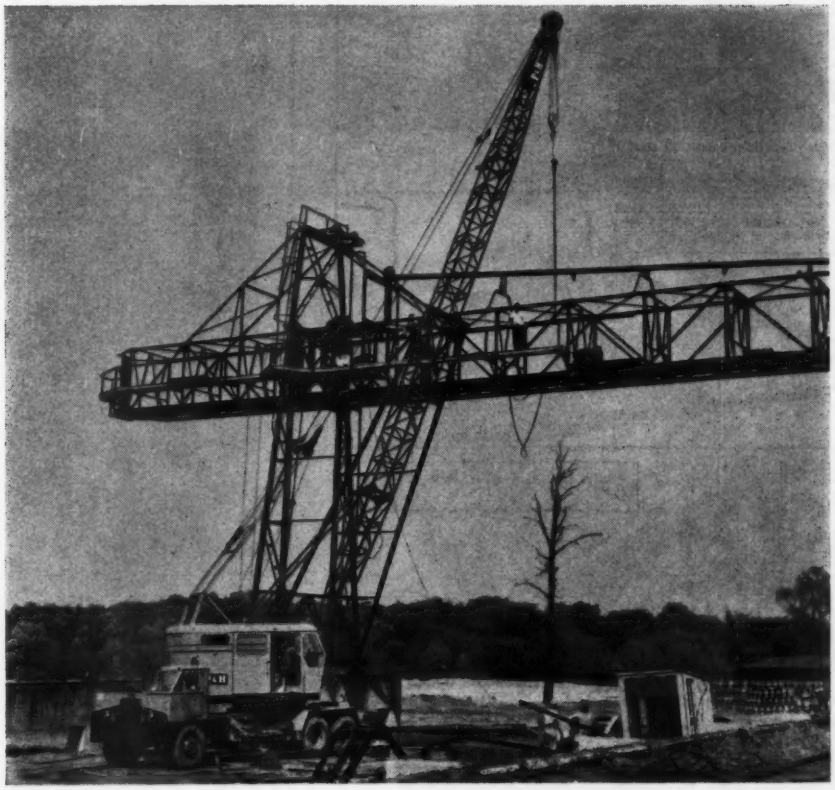

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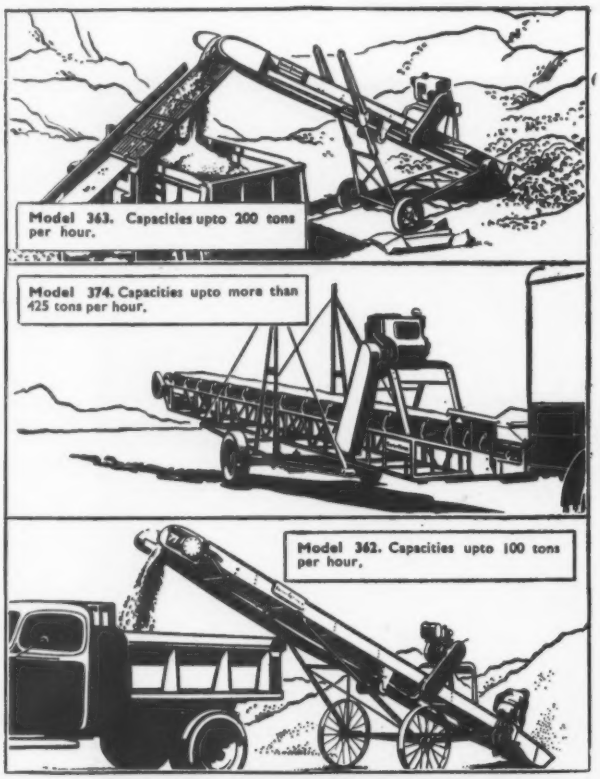
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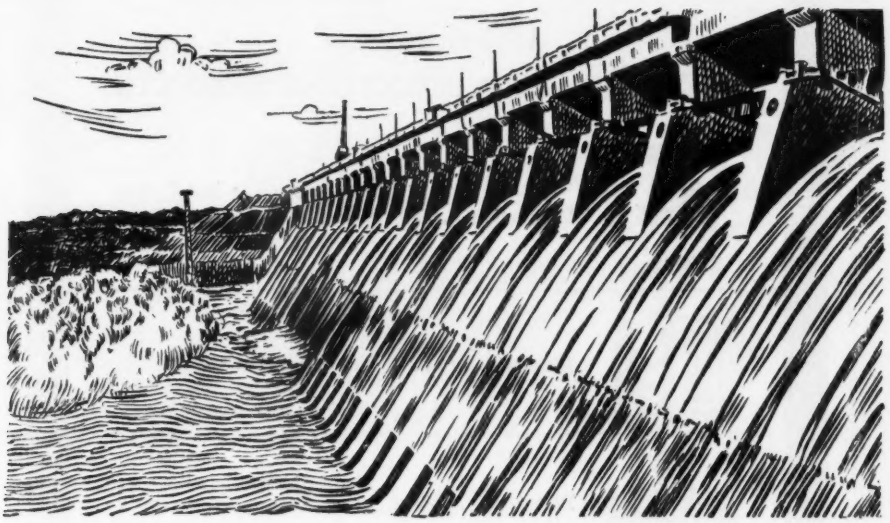

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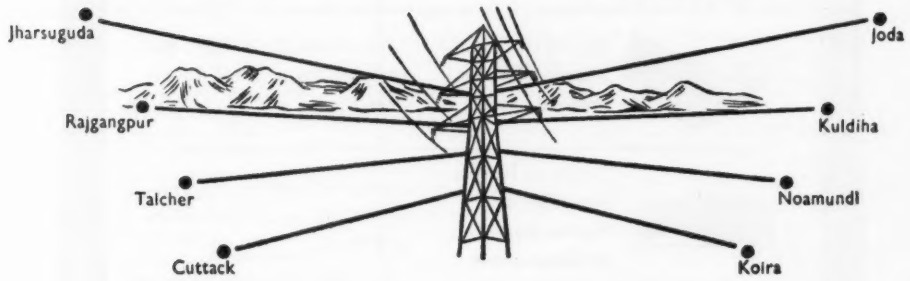

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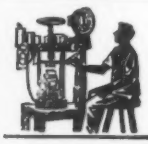

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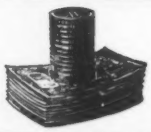

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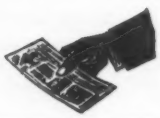

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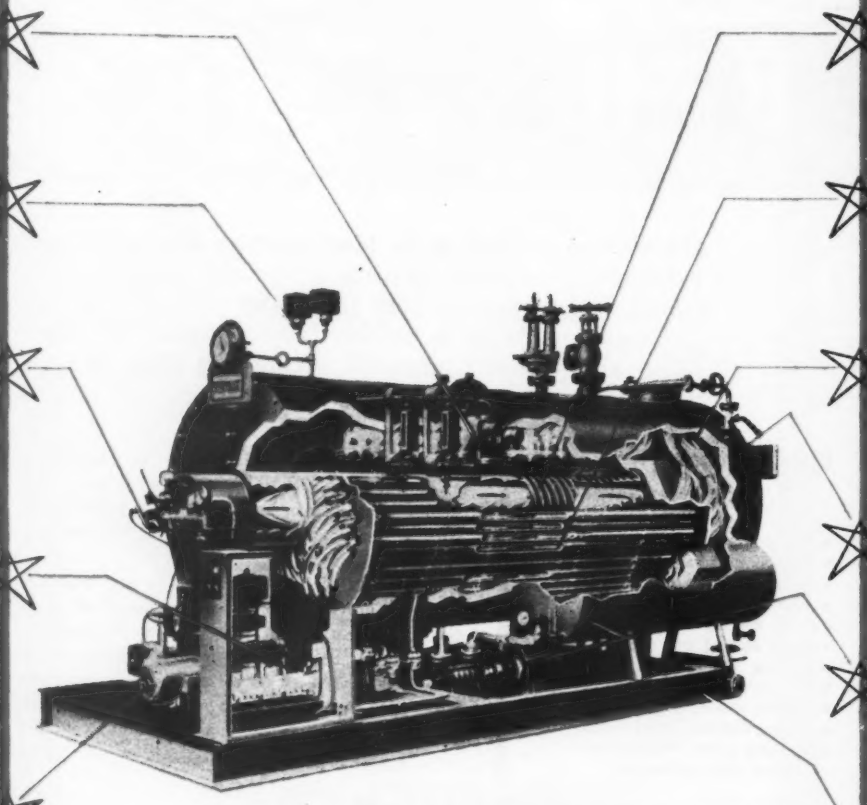

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Vol. VII **JANUARY 1957** **No. 1**

Orissa Irrigation and Power Development Number

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Perspective of Power Development in India *by* G. L. Nanda, Minister for Irrigation and Power ; Problems relating to Design of Large Turbine-Generators *by* D. H. D. Harms, Chief Design Engineer of A. E. G. ; Yellow River Basin Multipurpose Project *by* Cheng Hsuah Ming ; Thoughts on Irrigation and Valley Development in U.S.A. *by* C. S. Parthasarathy ; Second All India Power Engineers' Conference.

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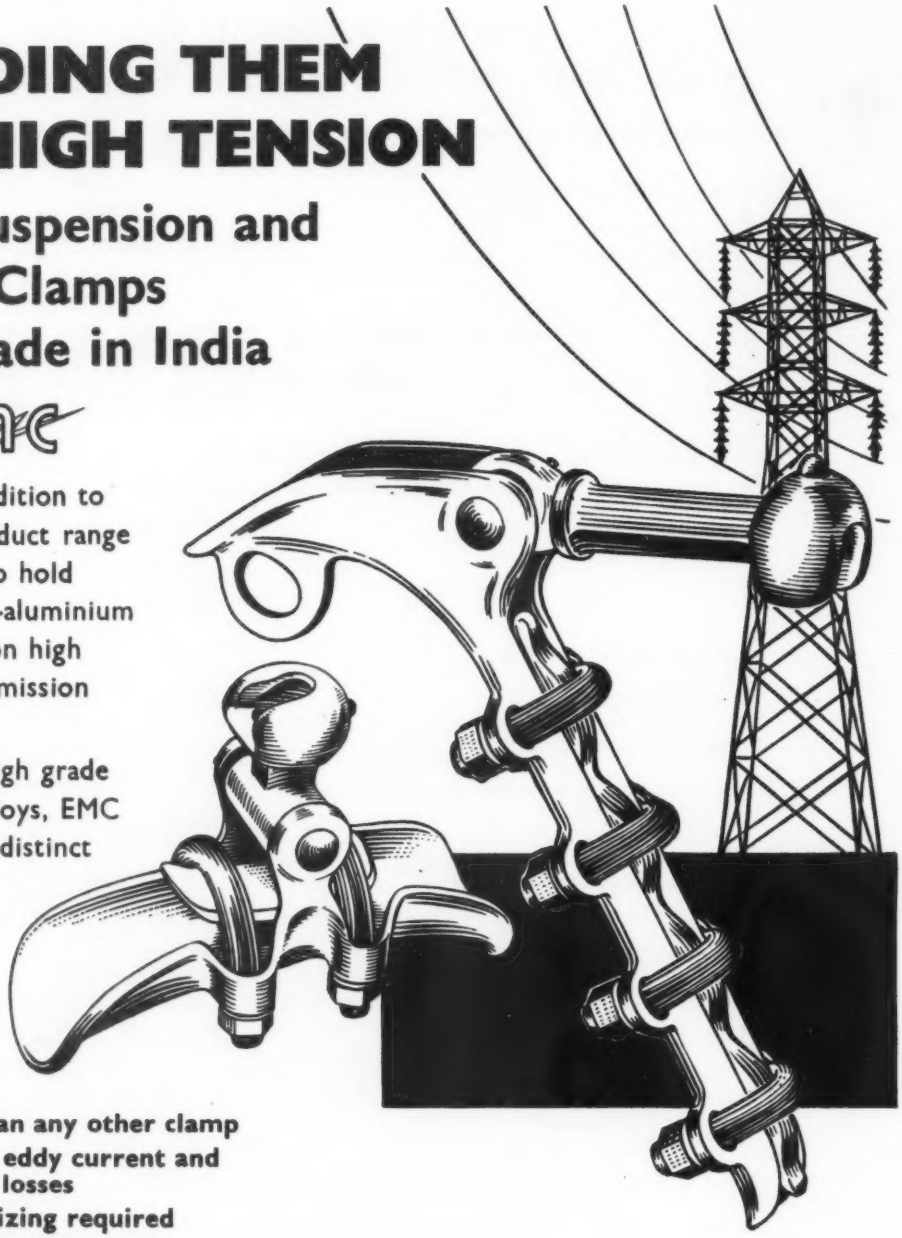

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Power Development in Orissa

By R. L. NARAYANAN
Chief Engineer, Electricity, Orissa.

Orissa has vast potentialities for hydro power and power from steam station using coal as fuel as it has a number of large rivers flowing through it and a number of coal mines producing fuel suitable for raising steam ; it has very extensive mineral wealth which can utilise the power for producing basic materials like iron, ferro-manganese, aluminium. It has got forest wealth which can be utilised to produce paper in large quantities and timber for various purposes and further, as it is an agricultural country, it can produce sugar-cane, cotton etc. which can be used in the various consumer industries. This wealth has not been tapped until recently to any extent but the process of utilising this wealth has now started. The progress in the beginning will naturally be slow as sufficient finance has to be found not only for producing power but also for the industries which will utilise that power and for transport to bring the raw materials to the factories and take away the finished products to the market. Further, machinery required for the various industries has to be obtained, often from abroad and this takes not only time and foreign exchange but, as they are in short supply, the industrialisation has to be phased suitably. Another bottleneck just now is the short supply of trained personnel, both supervisory and the skilled workmen type. We are at the beginning and we have to start almost from the scratch in all these respects.

On the power side, we are constructing the Machkund and Hirakud hydro-electric systems. The Machkund system has already started functioning and a unit of the Hirakud system was switched on at the end of last year. There are already two Thermal Stations in operation, one at Choudwar and the other at Chatrapur. A new Thermal Station is being erected at Balasore and there is proposal for another station in Rampur Colliery region. Besides, there are a number of diesel engine driven power houses catering for small interior areas.

At the beginning some people were pessimistic about the industries being capable of absorbing the power that will be produced in the Hirakud system in the first stage. Actually certain modifications were made in the construction programme on this basis. These are now found to be ill-advised as the load now is developing in such a manner that not only the power from the first stage of the Hirakud system will be absorbed quickly but the power produced by the full development of the Hirakud system will be absorbed by 1961. Therefore it has been found necessary to start work on the second stage of the Hirakud system immediately.

As mentioned above even the full development of the Hirakud system will be absorbed by 1961 and further development will be retarded unless further amount of power is made available in the State. The State has potentialities not only for producing power for its own use but can, to some extent, help the neighbouring States. With this in view other hydro-electric schemes are now under investigation : Bhimkund on the Baitarani, Tikerpara on the Mahanadi, Rengali on Brahmani, Balimela using Machkund waters. There are other rivers like the Kolab which can be harnessed to produce power at the Bagra Falls and the river Brahmani near Barahat can also be harnessed. Many of the rivers like Mahanadi, Brahmani and Baitarani cannot only produce wealth by the utilisation of water for irrigation for producing 2nd crops and to supply water during years of defficient rainfall for the 1st crop but they have, from time to time also caused vast devastation by floods. Small floods are of benefit, in that they fertilise the land but large floods producing standing water in the fields create havoc and therefore all the rivers have to be harnessed so that floods are moderated, as much water as can be used for irrigation utilised and power produced ; thus they are multi-purpose in their approach. These also reduce the burden on any one items of use from what it would have had to bear if the scheme was constructed solely for that particular use.

During the Second Five-Year Plan mainly the programme taken up during the First Plan period will be completed and further extended for achieving the maximum benefit. The Second Five-Year Plan, therefore, provides for the completion of the

(*i*) Hirakud Scheme to its full capacity of 2,32,500 kW. installed and the necessary transmission lines to utilise the power,

(*ii*) Machkund Hydro-Electric Scheme to its full capacity of 1,14,750 kW.

(*iii*) Duduma Transmission Scheme, particularly the extension from Rayagada to Berhampur.

(*iv*) Completion of the Hirakud Power Utilisation Scheme, and

(*v*) Extension of the programme of Rural Electrification to other small towns and rural areas of the State. A provision of Rs. 10 lakhs has

also been made for providing equipments on hire purchase basis to the consumers of such areas to create incentive to utilise electricity, for different beneficial purposes.

A provision of Rs. 25 lakhs has also been made for nationalising some of the private Electric Supply Companies which are not looking to the development of power supply in their areas, in the national interest.

Provision has also been made for the investigation of Tikerpara, Bhimkund, Balimela Hydro-Electric Projects and a scheme on the Brahmani probably at Rengali. Out of these at least one scheme, probably the Bhimkund Scheme on the Baitarani, will have to be started during the latter part of Second Five-Year Plan itself to cope with increased demand for power for which separate provision will be made either under the State Plan or under the Central Plan in due course.

About the close of the Second Five Year Plan we may have 235,500 kW. of power generated in the State itself—about 2,00,000 kW. from Hirakud and 25,500 kW. from Machkund Joint Hydro-Electric Scheme.

The development of load particularly to be served by Hirakud is growing very fast and with a view to finding the power for the industries pending the construction of a second Hydro-Electric Scheme and to firm up the power from the Hydro-Electric Schemes and increase the capacity of the latter by enabling the flow in a normal year rather than dry years to be utilised and to be a standby for emergency, the construction of a Steam Station with an installed capacity of 60 mW. M.C.R. near the Rampur Collieries is under consideration. This station if constructed will be connected to the Hirakud Transmission System at Jharsuguda Sub-Station.

The expenditure on the schemes included in the First Five Year Plan is Rs. 549.69 lakhs. The total provision made for the scheme included in the Second Five Year Plan amounts to Rs. 604 lakhs, Rs. 12 lakhs being spent on investigation of new projects.

The following additional transmission lines are envisaged :—

132 kV.—224 miles
33 kV.—200 miles
11 kV.—125 miles
L.T. Distribution—700 miles
200 villages are proposed to be electrified.

The present power plan is basically a plan at the State level, in keeping with the location of industries and availability of power for the purpose. For the Rural Electrification Scheme a provision has been made somewhat on a lump sum basis, but detailed plans and estimate etc. are under preparation. It is also contemplated to extend the benefit of electric power to the Community Projects and National Extension Block areas. Work to be done under the important Schemes are as follows :—

Hirakud Dam Project

The main object of Hirakud Dam Project is to control the floods of Mahanadi, enable regulated flow of water to be made available to generate hydro-electric power and to irrigate large tracts of land in Sambalpur, Cuttack and Puri districts of Orissa.

The Project comprises the construction of a concrete gravity type dam 3768 ft. long, earthen dam 11980 ft. long and dykes on both sides across the river Mahanadi on Orissa State. The concrete dam is 200 ft. high above deepest foundation. The culturable commanded area under flow irrigation will be 4,48,600 acres. Two canals take off from either side of the dam to irrigate lands in Sambalpur and Bolangirpatna districts. Total length of canal system is 574 miles. The Power House located at the dam, will have an ultimate installed capacity of 4 units of 37,500 kW. and 2 units of 24,000 kW. The installed capacity of the subsidiary dam will be 3 units of 24,000 kW. with provision for a 4th unit.

Machkund Hydro-Electric Scheme

The Scheme is being executed jointly by the Governments of Orissa and Andhra States. The 2nd stage of the Scheme is being implemented during the 2nd Five Year Plan and envisages installation of 3 additional sets of 17,500 kW. each, in addition to the 3 sets of similar capacity already installed in the 1st stage. By the end of the 2nd Five Year Plan firm power to the extent of 25,500 is expected to be the share of Orissa. Provision in the Second Five Year Plan for this scheme stands at Rs. 161.30 lakhs.

Duduma Transmission Scheme

In the Second Five Year Plan provision has been made for extension of 132 kV. line from Rayagada to Berhampur in order that the prosperous areas around Berhampur in the Ganjam district may have the benefit of development with the availability of cheap power from the Project. Provision for this Scheme in the 2nd Five Year Plan is Rs. 154.00 lakhs.

Hirakud Power Utilisation Scheme

A sum of Rs. 100 lakhs has been provided for this scheme in the Second Five Year Plan. Hydro power from Hirakud Dam Project will be made available through this Scheme to the different areas viz. Cuttack, Bhubaneswar, Khurda, Puri, Jagatsingpur, Kendrapara, Athgarh, Dhenkanal, Talcher, Sambalpur, Jharsuguda, Rajgangapur, Rourkela, Surdargarh, Barjamda, Joda, Rairangapur, Bargarh, Baraipali and a number of other places lying by the route of the sub-transmission lines constructed under this Scheme.

Small Towns and Rural Electrification Schemes

During the Second Five Year Plan greater attention is being given to Electrification Schemes in the Rural areas. A provision of Rs. 150 lakhs has been made in the Second Plan and it is programmed to electrify at least 200 villages and also extend help to rural consumers by way of providing equipments on hire purchase basis. Plan and estimates for 13 schemes at a total cost of Rs. 65.55 lakhs have already been approved by Government and they are being taken up in the current year for electrification of villages namely Bhograi, Digpahandi, Dharakot, Banki, Khandapara-Kantilo, Daspalla-Satpatna, Sasan Damodarpur, Chhaitana-Gop, Kesinga, Badkodanda, Junagarh and Balasore (through a Thermal Station). A further number of such schemes will be drawn up and imple-

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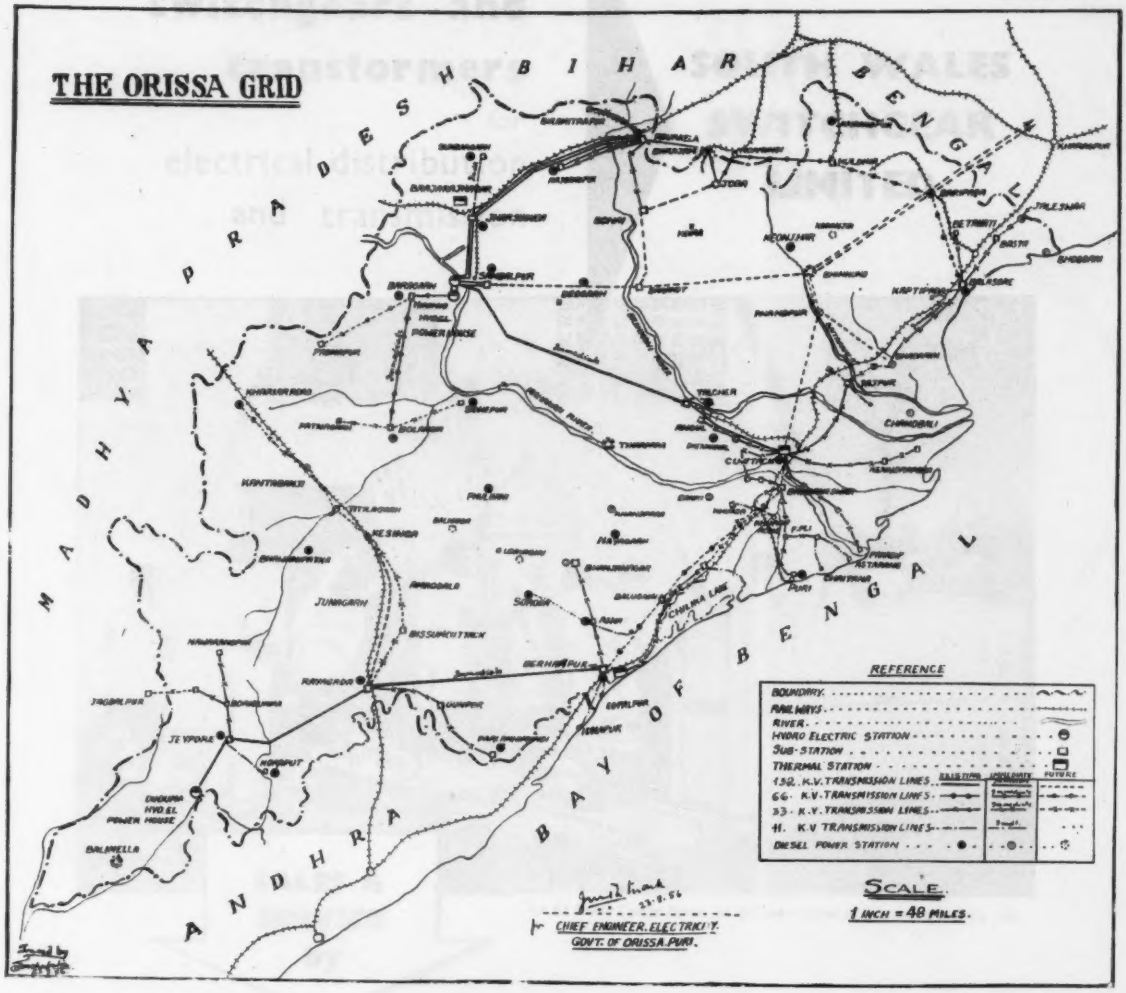

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Delta Irrigation Project

By K. M. BHATIA, I.S.E.
Additional Chief Engineer, Irrigation, Orissa

Orissa is fondly entering on the execution of what has come to be popularly known as Delta Irrigation Project. This project aims at the improvement of irrigation in the Mahanadi Delta by providing perennial supply as a result of the construction of Hirakud Dam in the upper reaches of the same river. A continuous supply of 8000 to 10000 cusecs in dry weather will be available in Mahanadi and it is proposed to utilise the bulk of discharge for extension of Rabi irrigation as well as bringing new areas under irrigation.

The Mahanadi, Brahmani and Baitarani, three of the five major rivers of Orissa are interconnected in the Delta and an irrigation system to utilise their waters was conceived as early as 1858 by Sir Arthur Cotton who had been responsible for the construction of irrigation works in the deltas of Godavari and Krishna. Here he estimated that an area of 2.5 million acres could be irrigated by a complete system of irrigation and navigation canals, special importance being attached to navigation to open up the area, destitute as it then was, of roads, railways or harbours and a company known as the East India Canal Irrigation Company was formed in 1860 to carry out the works. Though water for irrigation was first supplied in 1865 the works had not sufficiently advanced to be of any real use in the terrible famine of 1866 though they formed an excellent ground to provide relief work. However it soon became evident that the original estimate was likely to be considerably exceeded and as the Company found it difficult to carry on, the Government of India purchased all the works done up-to-date for 109 lakhs in the year 1869, when the Company ceased to exist.

The execution of these works have had, even after the Government took over, a checkered history and the estimates have been revised several times. The position today is that with a total outlay of Rs. 2,76,00,000/- the works provide for an irrigation ayacut of 4,05,974 acres. The canal irrigation is however relatively low being 194000 acres in Kharif and 77000 acres in Rabi. The canal system included Taladanda canal system taking off near Cuttack from the Mahanadi, the Kendrapara Canal and the H.L.C. Range I, systems taking off the Birupa near chowdwar, the H.L.C. range II and Dudhais Canal systems taking off the Brahmani near Jenapur and the H.L.C. Range No. III and Jajpur Canal systems taking off the Baitarani at Akhuapada.

A map showing the canal system as existing is plate I. There are 3 weirs viz., Naraj, Jobra and Birupa on Mahanadi system ; 2 weirs at Jenapur and Jokadia on Brahmani system and 2 weirs on the Baitarani and Burrah rivers at Akhuapada, also shown in the plate.

As a result of recurring floods, from which the Orissa Delta has constantly suffered and on the recommendation of 1928 Flood Enquiry Committee, the H.L.C. Range II and the Dudhai Canal and the weir on Brahmani at Jenapur have been abandoned.

The existing irrigation system has been a losing concern mainly because of a very low water rate which could not obviously be increased as the area is blessed with an annual rainfall of 62 inches on an average, and the cultivators used canal water only as a measure of insurance against uncertainties of rain. The canal administration provides for, such of the cultivator as want to use canal water, to enter into 10 years leases with Government, but when prices were low the cultivators were reluctant to enter into such leases as they would much rather prefer to lose the crop once every few years when rains failed than continue to pay for canal water even during years of good rain, which would normally mature their crops without the aid of irrigation. It is only after World War II when prices have stabilised to the advantage of the agriculturist that a keenness for irrigation has been felt.

Under the new proposals of Delta Irrigation scheme it is proposed to improve the existing system of canals fed from the Mahanadi system by remodelling them to carry higher discharges and thereby command more areas. Notable extension are the provision of irrigation for the first time in Nuna-Chitrotola island. Birupa Gengufi island and Kafgui-Biluakhai island. While the total existing area under Mahanadi system of canals which will be merged in the Delta Scheme is 4,05,974 acres, the total command after the completion of the Project both on new and old canals will be 10,77,157 acres. In other words 6,71,183 acres of agricultural land now depending on the rain will be provided with assured supply of irrigation by the proposed scheme.

The annual cultivation which is at present 1,94,000 acres in Kharif and 77,000 acres Rabi is expected to

rise to 11,85,000 acres in Kharif and 6,82,000 acres in Rabi after the Project is completed. The former includes the Sharad or winter rice crop.

A second map showing the new area that is being provided with a canal system and the old areas where the conditions of supply will be improved is Plate II.

In the present context of things the canals can only draw such of the supply as Mahanadi can afford to give. The three canal systems i.e., Taladanda Canal System, the Kendrapara Canal System and the H.L.C. Range I have a full supply capacity of 1401 cusecs, 2076 cusecs and 600 cusecs respectively. This total supply is not available in the Mahanadi during months of January to May when the river flow goes down to as much as 300 cusecs. These canals cannot, therefore, run as perennial channels, but with about 10,000 cusecs flowing down the Hirakud Lake a firm perennial supply will become available to the entire delta.

The Delta Irrigation Project is estimated to cost Rs. 14.92 crores and covers construction of a Pick-up-Weir at Naraj to feed a new canal having a full supply capacity of 5954 cusecs for Puri District. This canal divides itself into several branches to feed the areas between the Katjori Kushabhadra Doab, Kushabhadra Bhargovi Doab, Bhargovi Daya Doab as also areas on the right side of Daya river. These rivers as will be seen from the map are the Deltaic estuaries of the present Mahandi.

The existing Taladanda Canal is to be remodelled from its present full supply capacity of 1401 cusecs to 2168 cusecs to cater for an extra area of 32,493 acres, while the Kendrapara canal will similarly be enlarged from its present capacity of 2,076 cusecs to 3,262 cusecs and the H.L.C. Range I will be remodelled to carry a discharge of 572 cusecs against 600 cusecs (as orginally designed). The levels of waters in these canals are also proposed to be raised so as to provide for a better depth for navigation as well as to fit in with their increased capacity for irrigation. To achieve this rise in levels the project also provides for the remodelling of Jobra and Birupa weirs so that they will be in a position to maintain a minimum pond level of 69.05 and 68.83 against their respective levels of 67.55 and 67.33 obtaining at present. The existing 3.5 ft. shutters at Jobra are proposed to be replaced by 5ft. shutters and the Birupa Anicut also will have its present 4.5 ft. shutters substituted by 5 ft. shutters (The crest level of Birupa weir will also be raised by 1 foot).

The new weir at Naraj will be a masonry body wall 4298 ft. long with undersluices and appurtenant Head works for the Puri Canal. It has been sited just above the gorge at Naraj as the river flows in a most favourable curvature for the canal off-take at this point. The regulation of new weir also will be done by means of 5 ft. crest shutters.

Another important improvement that will be brought about in the system of irrigation could be the provision of water courses or field channels for economical distribution of water. The present system of irrigation by letting water flow from one field to another is wasteful.

It is a wellknown fact that the Orissa Deltas are subject to frequent heavy floods. As a result 980 miles of embankments have already been constructed to protect the existing irrigated as welll as rainfed agriculture lands. Naturally, therefore, when the new irrigation comes in, a reasonable immunity from floods is to be provided to enable this irrigation to flourish. For that matter not only have the existing embankments to be suitably strengthened and extended but the regulation of flood has also been so manipulated as to load each channel with that much of water as it can safely carry. A certain amount of flood moderation is ensured to the Delta by the lake at Hirakud, acting as a detention reservoir and sending only a moderated flood lower down. Even so the property to be protected is about 200 miles downstream of Hirakud and there are big tributaries like Tel which bring in heavy volumes into the parent Mahanadi during times of heavy rain. Unless these volumes are properly distributed between the various estuaries there is always the danger of one estuary developing at the cost of the other and this, if left to itself would be risky affair. For that purpose something is to be provided in the Delta Project to ensure that no channel is being loaded with more than what it can carry. Under the existing arrangements the only regulation whereby floods are distributed between the two channels is the existing weir at Naraj. This weir was necessitated to regulate the flow passing into the Katjuri as that river being lower would otherwise take away far more water than it can carry safely whereas the peak discharge recorded in the past in Mahanadi has been of the order of 15 lakhs of cusecs, the maximum discharge anticipated after the Hirakud moderation is likely to be of the order of 10 lakhs of cusecs. Model experiments have been conducted at Poona as to what levels would be obtained between Katjuri and Mahanadi for their existing regime for the moderated peak of 10 lakhs and to what extent the works should be modified or supplemented to achieve the end in view i.e. load each channel with what it can safely carry.

As a result of this study it has been proposed that not more than 4.0 lakhs of cusecs should go into the Kathjuri and of this only 50,000 cusecs should be allowed to get into the Kuakhai, which is an important estuary in the new Delta irrigation. Taking off opposite Cuttack from the Katjori river it flows as a single channel for a distance of 12 miles and then divides iteself into 3 estuaries, Kushabhadra, Bhargovi and Daya. These channels have a low carrying capacity and have been provided with high level escapes at Jogisahi, Ramchandrapur, Achutpur, Belmora, Madhipur and Kanti to relieve high levels of water in the event of heavy floods through stone pictched openings having crests at about their full bank stage of flow. As would be seen from plate II all these escapes have to be closed as canals have been sited along both the banks of these rivers and this makes it all the more necessary to control entry of water into Kuakhai and hence its 3 (three) sub-estuaries. The Kuakhai can only carry at best an optimum discharge of 50,000 cusecs and for this purpose the delta project provides for a control weir at the head of Kuakhai. It also includes a certain amount of remodelling of the Naraj weir so that Katjuri does not carry more than a total discharge of 4.0 lakhs cusecs.

Summarising, therefore, the Delta Irrigation Scheme,

Continued on page 24

PLATE I

INDEX MAP OF ORISS

SHOWING EXISTING

Scale 1 = 8 M

E I

ORISSA DELTA

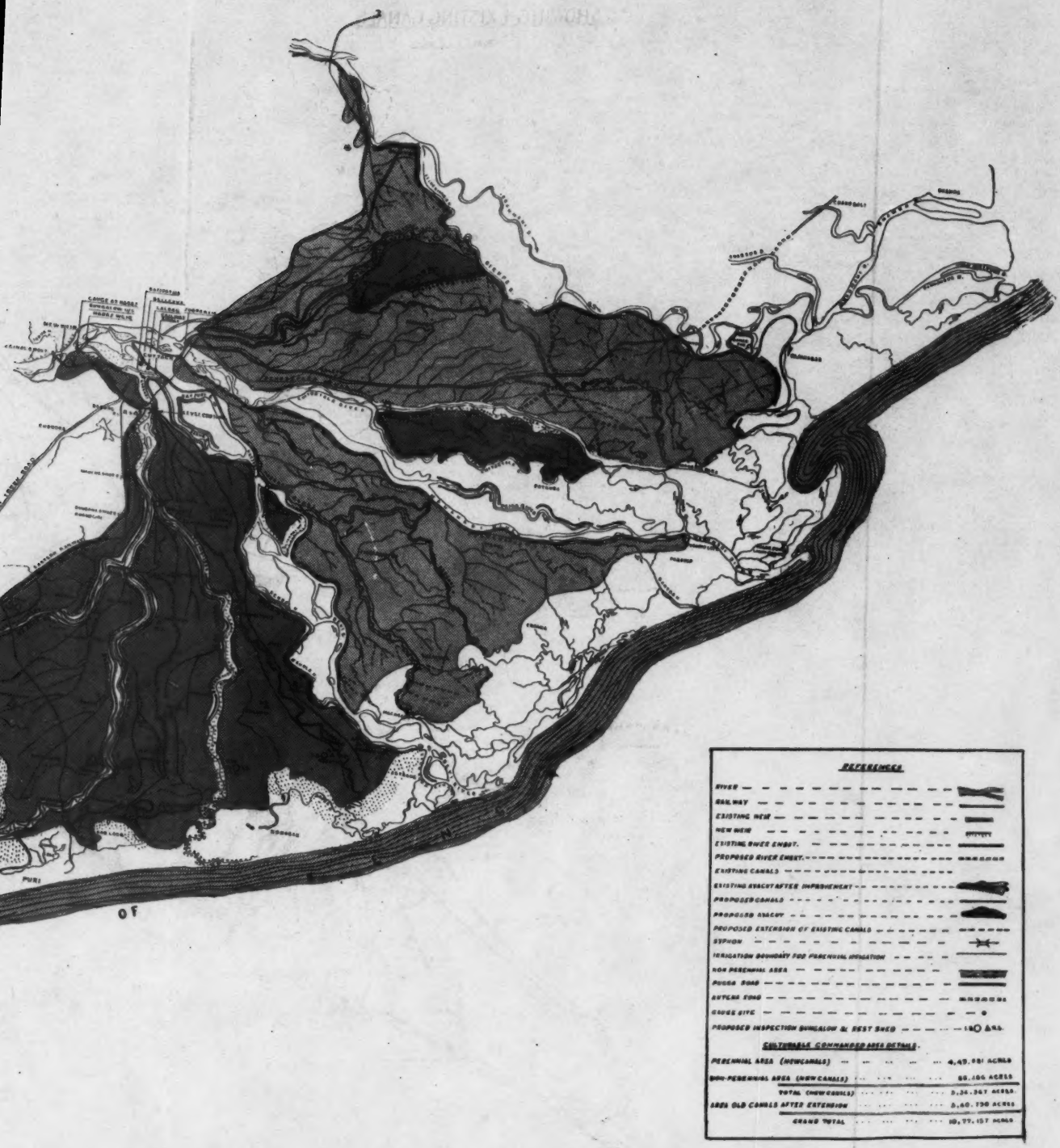
STING CANALS

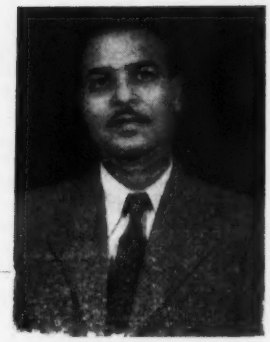
PLATE II

PROPOSALS FOR CONSTRUCTION OF NEW CANALS & EXTENSION OF EXISTING CANALS

IN CUTTACK & PURI DIST.

SCALE 1 inch = 4 miles


REFERENCES
RIVER
RAILWAY
EXISTING WEIR
NEW WEIR
EXISTING SLUICE EMBKT.
PROPOSED RIVER EMBKT.
EXISTING CANALS
EXISTING AQUEDUCT AFTER IMPROVEMENT
PROPOSED CANALS
PROPOSED AQUEDUCT
PROPOSED EXTENSION OF EXISTING CANALS
SYPHON
IRRIGATION BOUNDARY FOR PERENNIAL IRRIGATION
NON PERENNIAL AREA
PUCCA ROAD
KUTCHA ROAD
GAUGE SITE
PROPOSED INSPECTION BUNGALOW & REST SHED
CULTURABLE COMMANDED AREA DETAILS.
PERENNIAL AREA (NEW CANALS) ... 4,49,981 ACRES
NON-PERENNIAL AREA (NEW CANALS) ... 85,186 ACRES
TOTAL (NEW CANALS) ... 5,34,367 ACRES
AREA OLD CANALS AFTER EXTENSION ... 5,40,736 ACRES
GRAND TOTAL ... 10,77,157 ACRES



Power Utilisation in Orissa

By J. M. PATNAIK
Assistant to Chief Engineer, Electricity, Orissa

The picture of development of the State of Orissa cannot be taken to be complete unless due consideration is given to the aspect of utilisation of power. The various industries, existing, and potential, the amount and nature of the load requirements, any special features thereof, disposition of the loads etc. have a decisive influence on locating power generating stations, substations, transmission and distribution lines, the type of generation i.e. hydro, thermal or diesel. Also the features of load and future development will have to be thoroughly studied with a view to deciding the capacity and number of generating units and standby plant.

In the State of Orissa where abundance of raw material for industry is available, factories are located at convenient points keeping in view proximity of raw material deposits like manganese ore, dolomite, iron ore, lime stone etc, transport facilities and other factors. Electric power requirements of various industries under construction or proposed have been assumed both from data available for such industry and also after receiving requisitions from the concerns. Table "A" will give a list of major industries with their power requirements located in that part of the State served by Hirakud Hydel System. The total power requirement in the 1st stage comes to 1,91,000 kW and rising to 2,58,500 kW ultimately. Similarly Table "B" gives the industries with their power requirements in the area to be served by Machkund Hydel Scheme. The power requirement is of the order of 27,000 kW. Against these power demands it will be interesting to note that power generation in the 1st stage of Hirakud Project is 85,500 kW expected by 1957 and the ultimate power generation will be 2,00,000 kW by 1961. From Machkund Project we expect to get a share of 25,500 kW.

As complete reliability is aimed at on uninterrupted power supply to keep the wheels of industry moving, it is not only necessary to pay due attention to reliability of transmission system but also to generation side. During lean years—of insufficient rainfall and drought conditions—or of excessive draw-out of water from Hirakud Dam reservoir in any emergency, sufficient water may not be available for power generation. This will result in starving industry to the detriment of increasing production. It will be necessary to keep at least part of the industrial units going for sometime till things improve. Hence the necessity of inter-connecting grids and standby plants. At a future date it is proposed to cannect up Hirakud and Machkund Systems as also to bring to this common grid schemes like the Bhimkund project, the investigation work of which has been taken up. A standby Thermal Station of about 60,000 kW capacity (M.C.R.) is proposed near Jharsuguda which will be the load centre for industrial belt. The 5,000 kW Thermal Station at Choudwar, now in operation, will be on the grid both for standby purposes and to augment power shortages. Also another Thermal Station is under erection at Balasore of 2,000 kW capacity. The 4500 kW of the plant now installed at Rajgangpur will be left as a standby for the time being

Now, coming to the special nature of big loads that are catered for, say, ferromanganese factory at Joda in Hirakud System or at Rayagada in the Machkund System, the Steel Factory at Rourkella, or Aluminium Factory near Hirakud or Paper Mills at Choudwar. It is expected that two electric smelting furnaces will be installed at Rayagada for manufacture of ferromanganese. The furnaces will use 3,500 kVA and 7,500 kVA of power and load factor expected to be over 70%. Both working together will produce 12,000 to 15,000 tons of ferromanganese per year. Manganese ore is available is Rayagada and the factory is located nearby. Coke and limestone have to be brought from outside. A charge of manganese ore, coke or charcoal and limestone are fed continuously into the electric furnaces, smelted and finally tapped into trays. After cooling the tapping trays ferromanganese is separated from the slag, broken into small pieces and packed into drums. For every ton of ferromanganese produced 2 tons of manganese ore, 0.8 ton of coke, 0.8 ton of lime-stone are required. About 4 to 5 lakh gallons of cooling water may be required everyday for circulation. It will be interesting to note that 3000 to 3500 kWh of power and 70 lbs. of electrode (carbon) paste is required for one ton of finished product. The factory is fed by means of 132 kV transmission lines from Machkund Hydro Power Station at a distance of 94 miles. With the furnaces operating we do not expect any violent load/voltage fluctuations so as to affect the stability of the power system.

The aluminium factory is located very near to the Hirakud Generating Station and expected to consume 25,000kW of power in the 1st stage to produce 10,000 tons of ingots and double the amount finally. The load factor is expected to be over 90%. The principal items that affect the cost of the finished pro-

duce are alumina (ore), electrical power, electrode material and depreciation of plant. The electric furnaces under operation are nominally rated at 25,000 amps. while those in U.K. and U.S.A. are operating on 40 to 50 thousand amps. electric power required is of the order of 10 kWh per pound of aliminium. As the plant is located near to the generating station possibility of breakdowns of the short intervening transmission lines are less.

The steel factory at Rourkela expects to use 65,000 kW of power for the ultimate production of 1.0 million tons and for a fertiliser factory using coke-over gas etc. Supply is given through a D.C. 132 kV line, total length being 100 miles. Due to fluctuating nature of load and the distance it is proposed to instal synchronous condenser units, 3 nos. of 25 MVA capacity each, to correct voltage, power factor and stabilise load conditions in the system.

For paper making industry steam for processing purposes is required. In raising this steam, use also is made of this for generating some amount of electric power. For instance at the Titaghur Paper Mills at Choudwar power to the extent of 250 kW is expected to be generated by a pass-out turbo alternator in the 1st stage of development and 450 kW ultimately. The steam after producing this power is utilised at a lower pressure for proceessing purposes. Besides this power the total requirment will be 1100 kW in the 1st stage and 2000 kW ultimately. Hence power supply from the grid is to be maintained to the extent required and under certain conditions serve as standby for that block of power which is generated by the factory.

5000 kW of power will be supplied from the Hirakud system to the Bihar Government by running transmission lines from Nuamundi Substation. For Railway Electrification Schemes upto Rourkela power to the extent of 16000 kW will be supplied through the substation at Rourkela.

Rural Electrification Schemes and development of Small Scale Industries have also been taken up in the State on a large scale as part of utilisation of electric power. This has been dealt with in detail in another article.

Agreeable Tariff rates for power for various industries ; special rates depending on the bulk and nature of loads ; considerations of paying capacity of consumers, etc. have a bearing in attracting industry to areas where power development schemes are operated. It is not only in the interest of such schemes to make themselves paying but also in the overall interest of integrated development of the State that due attention towards proper utilisation of electric power is to be paid.

Table A—Loads in Hirakud Area

Nature of load	*1st Stage*	*Next Stage*
1. Aluminium Factory Hirakud	25,000	55,000
2. Steel Factory, Rourkela	65,000	65,000
3. Ferromanganese, Joda and Rayagada	16,000	36,000
4. Cement Factory, Rajgangpur.	6,000	8,500
5. Paper Industry.	6,500	11,500
6. Mining.	12,750	12,750
7. Railway Electrification.	—	16,000
8. Refractory Brick Plant.	3,000	3,000
9. Collieries.	3,350	3,350
10. Kalinga Tubes, Choudwar.	2,000	2,000
11. National Foundry and Rolling Mills.	250	250
12. Kalinga Industries.	5,000	10,000
13. Medium & Small Industries.	12,290	12,290
14. Sugar Mill.	500	500
15. Textile Mill.	2,360	2,360
16. Domestic Supply.	1,800	1,800
17. Bulk Supply to Licensees.	3,200	3,200
18. Other States (Bihar & Madhya Pradesh)	10,000	15,000
	191,000 kW	258,500 kW

Table B—Loads in Machkund Area

1. Ferro alloy.	16,000
2. Artificial Gem Factory.	1,000
3. Paper Mill.	3,000
4. Other large Industries.	2,200
5. Medium and small Industries.	2,250
6. Irrigation.	300
7. Domestic.	900
8. Bulk supply to Licensee.	1,400
	27,050

In 1949, when the work started at Hirakud Dam, 30 LeTourneau Earthmoving machines went into operation. Jungle clearing, levelling, road making and many other jobs were done by these machines. Later on 15 more electrically controlled Tournapull Scrapers were added to the existing fleet to cope with the vast construction work. These LeTourneau machines, following a tradition of service already set in the other huge undertakings throughout the world, have moved many millions cu. ft. of earth quickly and economically.

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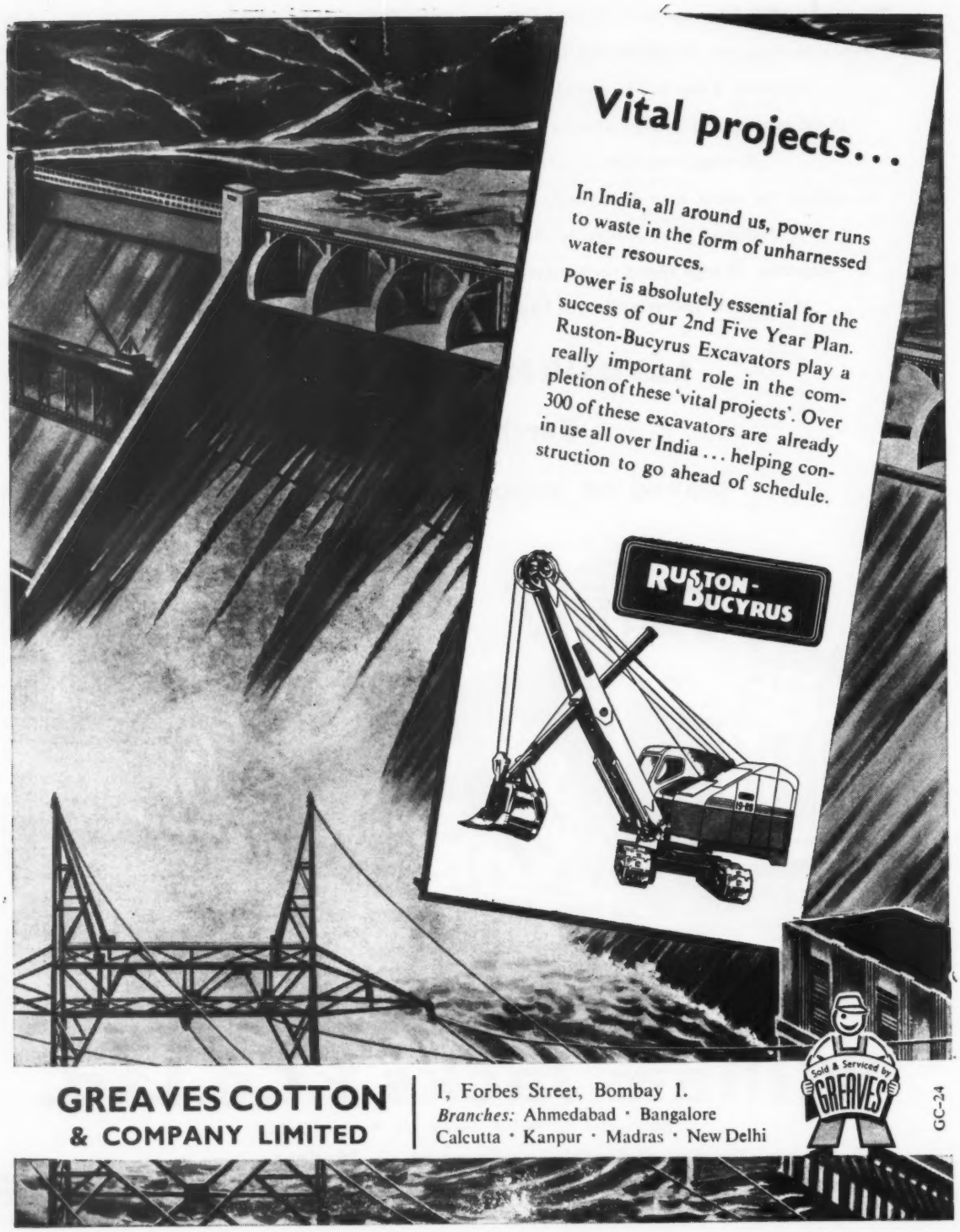
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Irrigation and its problems in Orissa

By B. N. SINHA
Department of Geography, Calcutta University

In a country like India, where more than 70.0 percent of the population are intimately connected with agriculture, and where agriculture is a gamble in the hands of the monsoons, irrigation is a necessity for agriculture. The uncertainty of the monsoon rain, its maldistribution, and often, great variation in the total amount of annual precipitation have forced the people and the government, to provide artificial irrigation against frequent crop failures. Even during the effective rainy season, which itself is short, rainfall is so erratic that sometimes the standing crops do not get water at a time when they require it most, and the harvest falls far short of expectation, disappointing the rural community. With the increase in population and the decrease in the land productivity the need for developing and stabilising irrigational facilities has become even much greater than before and now it can be said that irrigation holds the key to agricultural prosperity in Orissa. In more than 50% of the total surface area of Orissa 80 to 90% of the total annual precipitation is received only within 30-33% of the total number of days of the year, and the rest of the year remains almost dry (vide Map No 1 and 2). In the middle and upper catchment basins of the rivers of Orissa and in the Mahanadi delta, on an average more than 80%of the rain is received during the monsoons where as in the plains the percentage varies from 60-70% and hence the need for irrigation is greater in case of the former than the latter region. More than 90 percent of the total annual rain is received in Nowrangpore area of Koraput district which is the maximum in Orissa. Thus from the standpoint of precipitation, irrigation is of dire necessity in the middle and upper reaches of the rivers in Orissa. Again the hilly regions of Orissa are a component part of the undulating Gondwana topography and is composed of hard Archean rocks which reduce the soil porosity almost to minimum and hence accelerate the average surface run-off. A detailed investigation of the aspect of the moisture content of the soil in the off-monsoon period will lead us to establish the assumption that the curve for average moisture content will tend to have a downward tendency from the coastal plains to the inland regions of Orissa. Again the slopes are steeper in the rain-ward eastern slopes and hence has contributed to the greater surface run-off (vide Map. No. 3). All these lead us to conclude that irrigation is of dire necessity for 67-70% of the days of the year only to provide water to the root zones of the crops over half of the area of Orissa.

Major Canal Irrigation Systems

Under the present context of things the canal irrigation schemes can geographically be grouped into the following divisions :

(1) Rushikulya system.
(2) The Mahanadi system.
  (A) Area commanded by Hirakud system.
    (*a*) The lower Ong-Mahanadi-Doab.
      (*i*) The lower Ong-Jira doab.
      (*ii*) The middle and lower Jira and Jhaun basins.
      (*iii*) The Jhaun-Mahanadi doab (South of Barapahare)
    (*b*) South of Ib-Mahanadi doab.
  (B) The Delta systems :
    (*a*) The proposed Devi-Daya Sector 1.[1]
      (*i*) The Devi-Kushbhadra Sector, to be irrigated by canals No. 1 & 2.
      (*ii*) The Kushbhadra—Bhargavi sector to be irrigated by canals No. 3 & 4
      (*iii*) The Bhargavi Daya sector to be irrigated by canals No. 5 & 6.
      (*iv*) The Daya and the outer flanks of the Eastern Ghats to be irrigated by canals No. 7 & 8.
    (*b*) The present irrigation system (Mahanadi Division)[2]
      (*i*) The Devi-Mahanadi sector, irrigated by Talanda and Machagaon canals.
      (*ii*) The Mahanadi-cum-Chitrotala and Nuna—Birupa-cum-Brahmani sector irrigated by Kendrapara and Patamundai canals.
      (*iii*) The Birupa—Brahmani doab, irrigated by H.L.C.R. I
(3) The Brahmani—Baitarani section 3 was irrigated by H.L.C.R. II but at present abandoned.
(4) The Baitarani system :
    (*a*) Baitarani—Salandi doab is irrigated by H.L.C.R. III.

The Rushikulya System

The 1865-66 A.D. is a red-letter year in the history of Orissa because of the disasterous famine which occurred in the following year, it led the authorities to search out possibilities of providing irrigation facilities in the Rushikulya plains as productive and protective measures from the jaws of the vagaries of nature. A tentative plan was chalked out with an estimated expenditure of Rs. 28,60,239 by May 1882 and the actual execution of work commenced by 1884 with a revised estimation of total capital cost

of Rs. 49,45,820/- but the acutal operation of the project started in 1902-1903.

Like all other South Indian rivers, the problem of non-perenniality in water supply stood on the way but the undulating nature of topography helped the construction of two artificicial reservoirs (at Suruda and Russelkonda[4]) in the upstream of Mahanadi and Rushikulya to make the water supply permanent. The reservoir's water supply is supplemented by a six mile long channel from the river Gulleri, an affluent of river Mahanadi, by the construction of an anicut at Sorisomulu. In case of urgency water supply from the reservoir is allowed through Loharakandi river and is again picked up at Ghumsar by an anicut across Mahanadi, called the Ghumsar anicut. The Suruda reservoir (1755 million cubic feet) with a catchment area of 200 sq. miles (vide Table no. 1) supply the water to the Rushikulya river as far as Janamilli anicut where a head sluice for the Rushikulya canal is built. (vide map No. 6).

The Irrigation :

The Mahanadi canal with a total length of 19 miles takes off from Ghumusar anicut (500 ft.) which depends for its water supply on Mahanadi in the first instance and on the Russelkonda reservoir (2160 million cubic ft.) when the river supply fails. It has a designing capacity of irrigating 12,563 acres[5] and meets the river Rushikulya near Muclopolly where the Janamilli anicut (600 ft.) has been constructed to utilise the supply available in that river. The 50 mile long Rushikulya canal takes off from Janamilli anicut which has been designed to irrigate 82,840 acres. This canal is divided into 18 reaches and is proposed to have 16 distributaries in all of which no. 3, 4 and 6 have not been excavated (vide Table No. 2).

This project was orginally designed to serve the dual purpose of both irrigation from Aska to the shore cum navigation but finally navigation had to be abandoned because of the unfavourable topography. It was orginally hoped to irrigate 117,250 acres of Ghumusar and Berhampur Taluks[6] but the expectation falls short by 10,000 acres because of the failure of 10th distributary and the present estimation stands at 106,300 acres[7]. The canals are generally opened from 1st July to November in the Khariff season and the supply of water falls short in the rate excepting a limited quantity and hence the whole area is almost a region of single cropping. Virtually the canals have got very little value except protecting the paddy from seasonal rain failures and that is why the whole of project is running in a loss to the State exchequer[8].

The proposed Mahanadi development System

After the multipurpose scheme at Hirakud on the river Mahanadi reaches its completion, it will not only provide hydel power for our industries but also feed the irrigation canals with water for the betterment of the agrarian economy. It will irrigate portions of Sambalpur and Bolangir districts from the Hirakud reservoir and at the same time from the water that will be drained to the river to move the turbines for the generation of electricity is to be utilised by the construction of an anicut at Naraj across Mahanadi at the apex of the delta. Hence the proposed scheme can easily be split up into two separate divisions:

(1) The proposed Hirakud Division.
(2) The proposed Delta Division.

The Proposed Hirakud Division

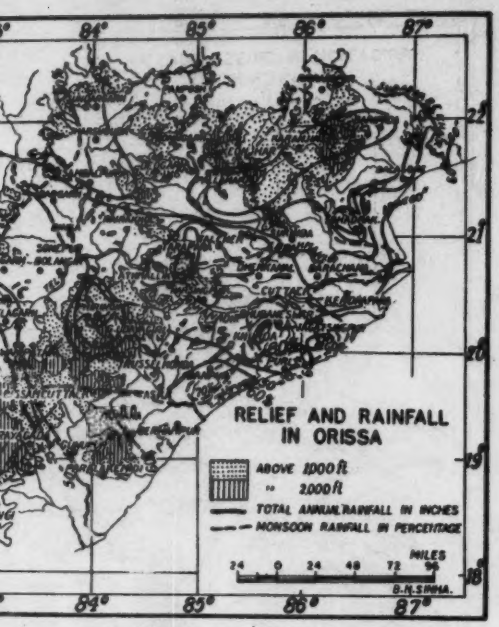
A 15,748 ft. long dam at Hirakud across Mahanadi, with a total estimated expenditure of 92.08 crores of rupees will create a reservoir with 4.72 million acre feet of live storage[9] which is sufficient enough to feed the proposed 589 mile long canal system. The irrigated areas can safely be divided into two distinct parts of which the river Mahanadi itself stands as the line of partition and they are popularly represented by Sambalpur and Bargarh towns on either side of the river. The area to be brought under irrigation sharply vary and according to the final estimation it has fallen markedly from the original estimation (vide tables no. 3 & 4).

According to 1947 estimation the total irrigated area of 875,210 acres has dwindled to 791,000 acres during the 1st five year plan period and finally in March 1954 it has been estimated to be 678,000 acres. This final estimation includes both flow and lift irrigation with three main flow canals of which two are on the left of the Mahanadi but the proportion of area to be irrigated on the right outweighs that of the left. This happens because of the unhospitable topographical features of the Jhaun-Jira and areas left of the Ong river basin. The canals are all gravity or contour which more or less follow the watershed of the drainage system. The Bargarh distributory follows the water partings of the Mahanadi-Jhaun, Jhaun-Jira and Jira-Ong rivers respectively (vide map No. 5). For future utilisation of the existing

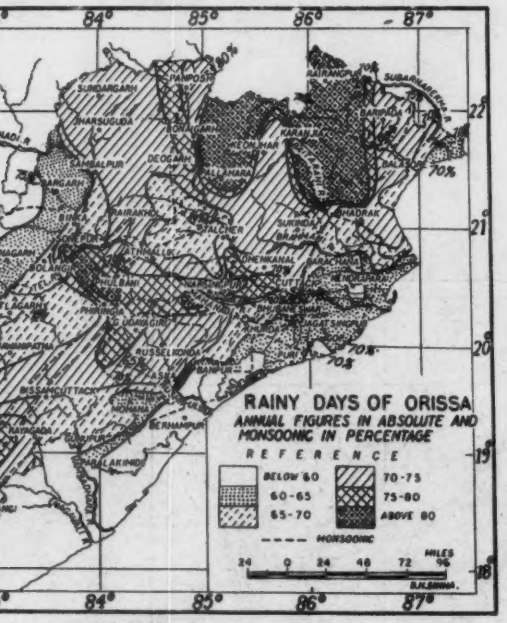
The anicut at Jobra, Cuttack, in the Mahanadi built to irrigate the delta.—*Photo by G. K. Mazumdar*

The sluice gate in the headwaters of the Taladanda navigable canal at Cuttack.—*Photo by Author*

82°
83°
22°
21°
20°
19°
MAHANADI R.
PATNAGARH
BOLANGIR
KHARIAR
TITLAGARH
SONEPUR
BARGARH
BINKA
BARAMBA
BISSAMCUTTACK
NAYAGARH
KHURDA
PURI
PIPLI
PURI
KONARK
PIPLI
KHURDA
NOWRANGPUR
RAYAGADA
G. VIZAG
GOPA
POTTANGI
MALKANGIRI
SILERU R.
70°



Map No. 1



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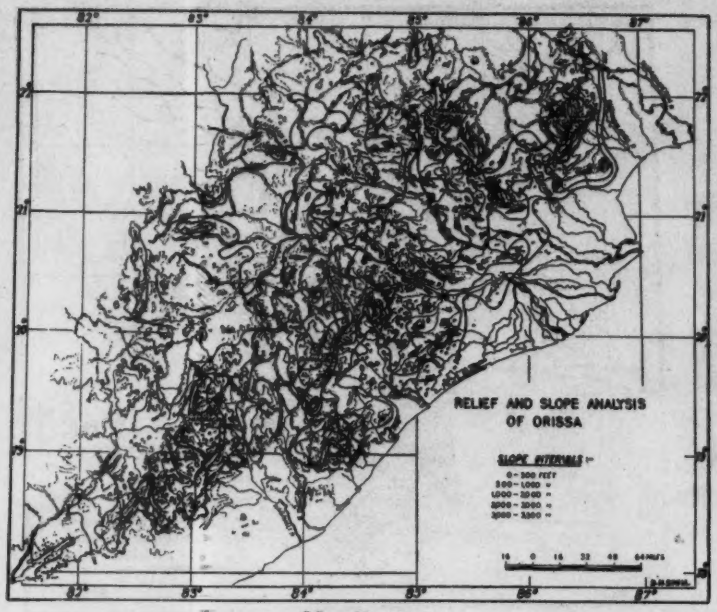

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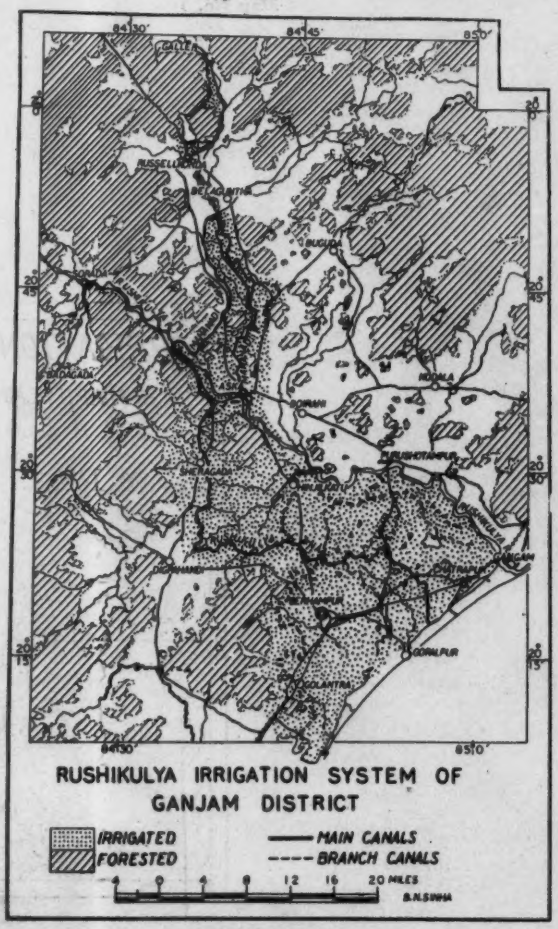

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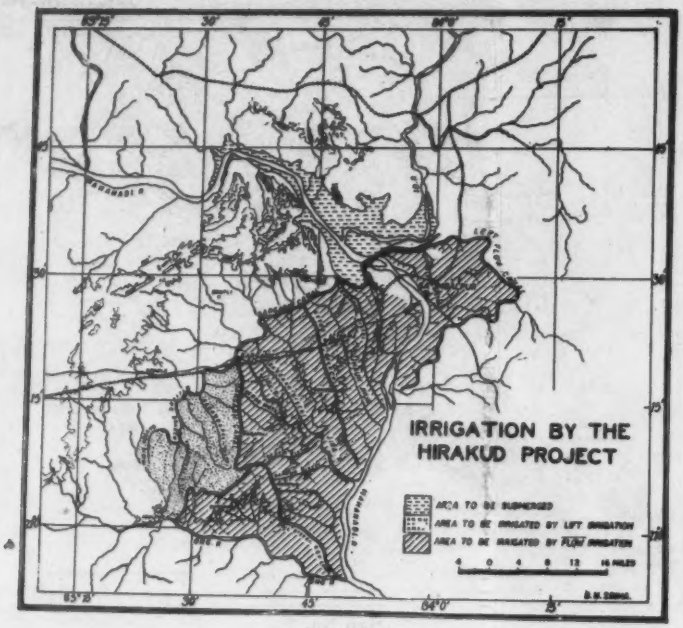
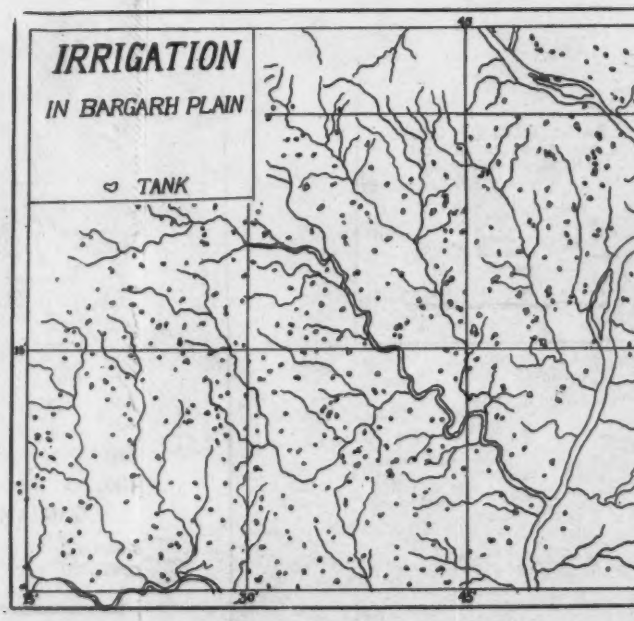


Map No. 5



Map No. 7

Reduced from Survey of India Map of 1"=

Map No. 6

p of 1"=4 miles

A view of Taladanda canal at Cuttack.—*Photo by Author*

A view of Kendrapara canal from the lock gate at Danpur.—*Photo by Author*

tanks, of varied sizes, which are irrigating lands in a limited form, can better be utilised if they are connected with the irrigational distributaries.[10] It is suggested that water supply to the irrigational canals will start by July 1956 whereas the first stage of the construction will be completed by the end of the year (vide Table No. 5). But now the first phase of the work is complete and the water is being supplied from the end of September 1956.

The proposed Delta Irrigation System

At Hirakud to generate a total Firm capacity both hydel and steam of 92,000 kW. water is to be discharged through sluices and that will make the present minimum discharge almost nine-fold through the Mahanadi[11] and to utilise this water for irrigational purposes in the deltaic area a scheme of 14.92 crores of rupees has been chalked out which is expected to reach its completion by 1958-59. According to this scheme not only new areas of the Mahanadi Delta of Puri district will be brought under the command of the canals but also the irrigated capacity of the present Mahanadi division will be extended by the supply of more water through the present canals.

To implement the present proposal another weir is to be constructed across the Mahanadi, further upstream from Naraj and the main canal will be taking its water from the right embankment of the Mahanadi. It is to cross the Kuakhai by a syphon and thence it is to enter Devi-Prachi sector which will be irrigated by the canal No. 1 and No. 2 The canal No. 2 will follow the Kushbhadra on her left bank and will irrigate Kushbhadra-Prachi sector ; whereas Canals No. 3 and 4 are designed to irrigate the region in between the Dhanua-Kushbhadra and Dhanua-Bhargavi rivers respectively. The main canal has entered the Kushbhadra and by another into the Bhargavi-Daya region at the former's head-waters. The Canals No. 5 and 6 follow the right and left embankments of Bhargavi and Daya respectively. The other two canals No.7 and 8 irrigate the region in between S.E.Rly. line in the West and river Daya in the east. The areas which are comparatively of high elevation to the west of the south eastern railway line are irrigated by a branch canal of No.8 by lift irrigation methods (vide map No. 6).

All the eight main canals follow the flow of the rivers which has helped in flow irrigation and they are contour canals which have got a design capacity of 10,77,157 acres of lands, inclusive of 54,0790 acres in the formerly irrigated region (vide Table No. 6).

The proposed irrigation system at Hirakud has got Khariff and Rabi intensity of 100% and 50% respectively against 110 and 67 per cent of that of the Mahanadi delta. It is anticipated that the Khariff areas will be fully developed within a period of five years while it may take complete ten years for the full development of the Hirakud areas but this period will be shorter in case of the Delta as the agriculture is already in an advanced stage and in the very first year of its completion it is anticipated that 25 percent of Ravi development against the present percentage of 19[12] will be achieved. The irrigable area at Hirakud is taken as two-thirds of the gross area and among the distribution of crops paddy stands the highest (vide Table No. 7).

Increased area under irrigation will bring an extra yield of 95 lakh maunds of paddy per year[13] and the comparatively high-lands will be greatly benefited as at the present set up they are treated as cultivable waste.

Irrigation in the Mahanadi Delta

The Mahanadi Delta receives a total annual (average) rainfall of 60". It is not the total, as its uneven distribution that limits successful agriculture in the delta. More than 78 per cent of the total rainfall is confined to only four months of the year with little or no rain in the winter months (vide Table No. 8).

To be free from the vagaries of rainfall, a canal irrigation scheme was first undertaken in the area under discussion, during the years 1863-64 by a private company[14] under the guidance of Sir Arthur Cotton and canal water was first supplied in 1869.

Irigation types and practices

Major Irrigation

(*i*) Canal irrigation
(*ii*) Inundation canal irrigation

Major Irrigation

(*i*) Canal Irrigation : The canals are all contour canals and are fed by the Mahanadi, and the entire system is called "The Mahanadi Division." To supply water to the canals of this system, three

anicuts have been constructed. The anicut at Naraj (3,833 ft. long) at the head of the Kathajuri serves as a feeder anicut by diverting the water to the Mahanadi. The anicut at Jobra (6,349 ft. long) and on on Birupa (1,980 ft. long) help in making an artificial lake at the head of the confluence of the Mahanadi.

The canals may be grouped into three sub-divisions :

(*a*) Canals of the Devi-Mahanadi sector :

(*i*) Machagan Canal
(*ii*) Taldanda Canal

(*b*) Canals of the Mahanadi-Birupa sector :

(*i*) Kendrapara Canal
(*ii*) Kendrapara Extension Canal
(*iii*) Patamundai Canal
(*iv* Gobari Canal
(*v*) Gobari Extension Canal

(*c*) Canals outside the delta limit

(*i*) High-level Canal Range I
(*ii*) High-level Canal Range II
(*iii*) High-level Canal Range III

For administrative purposes the area under the command of the existing canals is divided into four sub-divisions (vide Table No. 9).

The total irrigation area increased from 193,000 acres in 1946-47 to 197,500 acres in 1950-51. Of all the individual canals, the Kendrapara canal irrigates the largest acreage whereas the smallest acreage is irrigated by the Gobari canal (vide Table No. 10).

(*ii*) *Indundation Canals*

There canals are locally known as 'Kaja' and were designed mainly for two purposes, namely,

(*i*) the purpose of functioning as 'escapes' for extra flood water and thus to protect the embankments from breaches ; and
(*ii*) to supply water to the paddy fields with deficit water supply.

Cultivation and Irrigation

The response of the cultivation to irrigation is unique in the Mahanadi Delta. Irrigation provides security, often leads to bumper harvests, and brings economic stability for the agriculturist. In the Mahanadi Delta, not only the out-turn per acre and crop rotation is influenced but also the per capita income of the agrarian population is largely determined by irrigation. Irrigation also influences the pressure of population, intensity of paddy cultivation, percentage of double cropping, per capita distribution of cultivated land and, above all, the average size of the cultivated plots (vide Table No. 11).

The greater yield of paddy per acre (13 mds. to 15 mds.) in the canalised areas (compared with 10 to 13 mds., in the flooded tracts) roughly coincides with that in the areas of tripple cropping (jute, rice and pulses) in the irrigated areas. Peculiarly enough, jute cultivation is confined to the irrigated areas of Kendrapara and Cuttack sub-divisions, and is completely absent in the flooded tracts of Puri sub-division. To regain the lost fertility through intensive cultivation, by the process of nitrogen-fixation, the cultivation of leguminous crops is in wide practice in the canalised areas of the Mahanadi Delta. The intensity of paddy cultivation is slightly low in these regions, compared with that of the flooded tracts of Puri sub-divisions. The areas of greater percentage of double cropping roughly coincide with the areas receiving irrigated water. (vide table No. 12).

All these summed up together have resulted in a greater density of population and hence lower per capita cropped land and smaller average size of the cultivated plots in the irrigated than in the non-irrigated tracts.

Are the Irrigation Facilities Adequate ?

Our ever-growing population is facing the ever decreasing production of crops. The area under irrigation on the other hand has remained more or less static. Only 10.4 per cent of the total cultivated land in the Mahanadi delta is irrigated while nine-tenths of the entire area is deprived of such facilities (vide Table No. 13).

The need for irrigation is great in the region bounded by the Kathjuri-Devi in the east and Kuakhai-Daya in the west. In the Delta, as a whole it is clear how 90 percent of the cultivated area depends on the most undependable rains. Herein lies the need for increasing the area under irrigation.

The results of siltation due to the anicut at Jobra. River islands have been formed, as seen in the photograph.—*Photo by Author*

The lift irrigation in the upper reaches of the Mahanadi Delta. It is lifted because of the low level of the sub-soil water table.—*Photo by N. Prusti*

The Problem

One of the most fundamental drawbacks of the existing canal system is that the original plan was executed "rather too hurriedly" without a detailed consideration of its future effects on the agrarian economy of the delta. As a result of the construction of the anicut at Naraj, the average annual discharge in the Kathjuri decreased and consequently the river's carrying capacity diminished considerably. This resulted in the rise of the level of the Kuakhai head at the point of bifurcation from Kathjuri. Thus floods are becoming rarer in low and medium flood levels in the Daya-Kusabhadra sector than before. This has led to the development of moribund conditions and consequently due to water-logging malaria has become a common disease in these areas. Thus the agriculturists are becoming increasingly inefficient to discharge the farm operations successfully as most of them are confined to bed for a greater part of the rainy season, and hence, per acre yield is gradually falling.

The other problem of canal irrigation, today, is the lack of supply of irrigation water. Due to considerable fall in the discharge of water in the Mahanadi during the winter and early summer the canals fail to supply water for argicultural purposes from April to June. But this is the season of low rainfall, when water is greatly needed for early jute crop or early sowing of paddy.

As regards a solution for the development of the moribund condition, it may be said that there is no complete escape from it, though it could have been done if the present Naraj Dam would have been constructed a little below the present reservoir from which canals could have been extended to the Devi-Kushabhadra sector. The present moribund condition of the rivers like Daya, Bharagabi and Kushabhadra can be averted if the Kuakhai head could be brought to its former supply which can be solved after construction of the proposed Dam at Naraj under the Mahanadi Valley development scheme.

An analysis of the areas irrigated by the canals of Mahanadi Division reveals that even though there has been an overall increase in the irrigated area during the fiscal year of 1952-53 than that of 1947-48, it is less than that of the previous two years. But the areas under the long lease always expanded whereas the season lease is always subjected to fluctuations. (vide Table No. 14).

The relation between the rainfall and the demand for irrigation cannot be ignored on any account but the fact will be misrepresented if the combined rain of both Kharif and Rabi seasons[15] is be taken into account. The rainfall during the Khariff season mainly accounts for major variations in the irrigation acerage, as a decrease in Khariff rain leads to greater demand for irrigation and vice versa from 1947-48 to 1952-53, with only possible exception of 1950-51.[16] (vide Tables No 15 & 16).

The Baitarani System

The Baitarani system consists of two anicuts, one at Akhuapada (1015 ft.) in the river Baitarani itself and the other at Malandpur (526ft.) on Barhamani river. The H.L.C. Range III and Jajpur canals are fed from these two reservoirs, formed by two anicuts over the respective rivers for most part of the year and it has a total irrigation capacity of 46,000 acres while the Jajpur canal is also navigable for 6 miles. This system has got a total length of 22 miles of main canals and 140 miles of distributaries. (vide Table No. 16).

The most fundamental problem of all the systems of Orissa is the general apathetic attitude of the people towards the irrigation schemes and this is mainly because of the heavy rainfall during the paddy season. This leads to a variable policy in fixing up water rates which definitely st nd at a lower level than in the other parts of India and this again fluctuates with the prices of paddy. Water rates were lowered in 1931 but again these were raised to the former level from the season of 1948-1949 and that is why the whole system is running from a profit of about Rs. 1 lakh to a loss of about Rs. 5 lakhs per annum.[17]

The other problem involved is the lack of water when it is needed most i.e., the water supply is stopped from 1st April to 15th June and at times upto the end of June. This hampers the early sowing of jute which in turn affects paddy, the principal staple crop by shortening the growing period. As almost the whole area is leased out on long term basis, which runs for a period of ten years, it affects the tillers in the sense that any sudden seasonal fluctuation in price level of paddy and jute does not make any change in the water rate within the lease period. At least from this point of consideration annual leases are all the more preferable both for the government and the lessee. There is also a seasonal demand in a limited form for rabi crops including Dalua or spring rice which is grown in swampy lands of the delta.

The Brahmani System

The Brahmani system has ceased to be an important one in the field of canal irrigation in Orissa due to the deterioration of the Brahmani river which has led to the abandonment and finally dismantlement of the Brahmani river anicut (4000 ft.). The H.L.C.R. II and the small Didhi channel from the left bank of Brahmani has been abandoned and the H.L.C.R.I is only fed from the Birupa but the Patia anicut (783 ft.) which is a part of the Brahmani system is still maintained.

The most fundamental problem associated with this system is the question of silt. Its importance is easily fathomable from the very fact that the entire system had to be abandoned as the anicut at the apex of the delta was completely silted up and this could had been solved if a few more subsidiary dams upstreams would have been constructed.

The proposed Salandi System

The river Salandi has been proposed to be dammed and it is estimated to irrigate about 115,000 acres but this figure is only tentative and likely to vary (No detailed facts are available).

Efficiency of the Canal System in Orissa

The efficiency of the individual canal systems in Orissa is directly controlled by the environmental factors amongst which morphology tops the list and it can be better appreciated when compared with the area served by irrigation-cum-total population benefited thereby. In our discussion the proposed systems

have also been taken for consideration as sooner or later they willl lay a helping hand to influencing the agronomy in Orissa. It has become crystal clear that so far as the question of irrigation is concerned the proposed delta division stands first and succeeded by the proposed Hirakud system. The existing canal system under the Mahanadi division stands third in capability of irrigating land (by single mile of canal system) (vide Table No. 17). But the order is reversed when the question of population affected becomes the criteria and the old Mahanadi Division leads others with a big gulf and is followed by Baitarani and Rushikulya systems in order of arrangement. This happens because in the Mahanadi delta the pressure of population per square mile is the highest. Thus it can safely be concluded that the proposed Hirakud and Delta Divisions are less efficient at present only because less number of people will be benefited by them and again at the same time it foretells that there is enough room for optimum utilisation since those areas have got a vast potentiality in carrying pressure of population per unit of land after irrigation schemes are worked out.

Minor Irrigation .

Like all other rural parts of India in a rolling upland country where the inhospitable orographical features have stood on the way of launching major canal irrigational schemes, minor irrigation has played its unquestioned role of determining the economic standard of the people who inhabit it. From time immemorial in the Gondwana undulating topography of Orissa many sources of water like tanks and 'bunds' have provided insurance to the farmers against the crop failures in the seasons of draught or late rain. The importance of such sources has got special consideration in a state like Orissa where about 60% of the surface are above 1000 ft. contour line which is physically deprived of being fed with non-perennial to perennial canals and the main rivers with summer discharges extremely low to be of optimum benefit for irrigational purposes with least expenses. (vide Table No 18).

With these two basic factors in the background the low expenses for the execution and maintenance, with no demand for technical knowledge for the execution of these projects should have been better emphasised by the authorities concerned than that of today, especially when we are planning for rural development work[18]. The total amount allowed to be spent over these heads is even less than one sixth of the total amount alloted during the First Five Year Plan period in Orissa where about three-fourths of the total population are dependent on agriculture which in turn is precariously a tool in the hands of uncertain monsoons.

Its Historical Aspect

In April 1942 the Grow More Food Campaign, a drive for more production, was launched in Orissa and from 1943-44 schemes for supplying more water for irrigational purposes was taken to hand both for productive and protective purposes. The schemes included the digging of new tanks,. renovating old ones and bunding the small hilll streams. Accordingly 600 new tanks and the renovation of an equal number of old ones were taken up which were subsidised by the government[19]. But during the fiscal year of 1945-46 according to the changing policy of the government of India the entire amount was given as a loan, repayable in three years, interest free for the first year and at the time of realisation a portion of loan was remitted as subsidy. Of the minor irrigation works 25% of the cost was subsidised and the rest was given as loan whereas in case of bunding the hill streams, repairs to saline and flood embankments and construction of sluices 50% was given as subsidy and the rest as interest-free loan. In 1948 rules were provided by the Government of India for the projects of 1949 that the farmer should contribute a part of the cost and the rest to be subsidised by the government for the unremunerative portion which amounted to 50% of the total estimated cost. On April 21st, 1949, it was divised to empower the Collector to approve and authorise works upto Rs. 10,000 each of which the Commissioner vested with the same power upto Rs. 25,000/- but works costing more than this amount was to be done by the P.W.D.

In 1948 the rules provided that public project[20] were to be financed wholly by the government while the private projects were to be subsidised upto the extent of the half of the cost and the public schemes were also eligible but the grant was limited to the extent the schemes were non-remunerative. This policy of the Government of India was also modified and accordingly for private irrigation works from 1952-53 to 1956 government assistance was to be given upto the extent of two third of the total cost in case of new projects while upto 50% in case of old ones. So far the projects that started during the year 1951-52 were concerned it was decided by the State Government to adhere to the old decision as regards the villagers' contribution towards the project. This policy of giving subsidy was also changed and it dropped to only 25% of the cost of the private schemes but it has not been possible to work out schemes whith such a low assistance from the government because of the low paying capacity of the villagers and the general apathetic attitude to such schemes, especially when they are asked for 75% of the total cost of construction during the year 1953-54. Besides this financial problem another technical problem was faced. The schemes that were executed by the Board of Revenue were treated as private projects but the owner of the land had to transfer the land of the site of the project to the government and the difficulty was the conception of private projects on government lands. To solve this the transfer of the land to the government should be stopped. The recent policy laid down by the government is that for future minor irrigation projects no contribution from the people will be realised but on the other hand water rate will be charged immediately after water is supplied from new projects. In case of renovation of the old irrigation projects charges will be levied on additional areas brought under irrigation, and on old irrigated areas only when additional benefit accrues which will be proportional to the benefit[21]. So far in the schemes in which public money has been invested the actual collection will begin after people's contribution and repaid by granting remission for a few years. The projects will be taken up when the cost does not exceed Rs. 100 per acre of land and the schemes which will cost more will be taken up if the people to be benefited agree to repay in the form of betterment levy, to be realised in easy instalments in addition to water rates.

TABLE NO. 1

Reservoirs	*The rivers dammed*	*Total capacity (Million cubic) ft*	*Catchment basins (Sq miles)*
Russelkonda	Boringa Nalla[1]	2,160 with F.T.L. at 310.70	25
Suruda	Pathma[2]	1,755 with F.T.L. at 294.00	200

[1] An affluent of the Lokarkandi river which joins the Mahanadi.
[2] An affluent of the Jhoro river (or Jooroonadi) which joins Rushikulya near Suruda.

TABLE NO. 2

The Rushykulya system

	Main canals		*Distributaries*		*Total*		*Area irrigated*
Name	*Miles*	*Fur*	*Miles*	*Fur*	*Miles*	*Fur*	*(in acres)*
Mahanadi.	18	7	..	..	18	7	12,563
Rushikulya.	54	3	230	0	284	3	82,840
Total	73	2	230	0	303	2	95,403

TABLE NO. 3

Original estimation of Irrigation by the Hirakud Dam Project

Canals	*Gross commanded area (in acres)*	*Irrigated area (in acres)*	*Discharge (Cusecs)*
Left side lift canal	110,000	73,000	737
Left side flow canal	192,000	128,000	1,287
Irrigation from power channel	250,000	166,710	17,676
Right side flow canal	300,000	200,000	2,013
Right side lift canal	436,000	290,000	2,920
Foreshore canal	25,000	16,000	167
Total	1,313,000	875,210	8,800

(Vide Mahanadi Valley Development, Hirakud Dam Project. Government of India. Central Waterways, Irrigation and Navigation Commission. pp. 51).

TABLE NO. 4

Irrigation by the Hirakud Dam Project (Final)

Canals	*Sambalpur*	*Delta Irrigation*
Gross commanded area	643,000 Acres.	1,381,701 Acres.
C.C.A. under irrigation	542,000 ,,	1,077,157 ,,
Annual irrigated area	791,000 ,,	1,867,094 ,,
Length of the main canals and branches	116 Miles.	436 Miles.
Length of the distributaries and minors	473 ,,	205 ,,
Total cost Rs.	8,42,68,000	Rs. 14,92 crores.

(Vide The First Five Year Plan, Cabinet (Planning) Department, Government of Orissa, pp. 129).

TABLE NO. 5

Area irrigated by the Hirakud Dam Project

Canals	*Commanded Area (in acres)*		*Area to be irrigated*
	Gross	*Culturable*	
Right side flow Bargarh Canal	452,000	380,000	570,000
Left side flow Sambalpur canal	89,100	73,000	108,000
Total	541,100	453,000	678,000

(Vide Hirakud Dam Project. Index Map. Government of India, Ministry of Irrigation and Power, Burla, March, 1954).

TABLE NO. 6

The Proposed Delta Division

Descriptions		*Area to be irrigated*
The Perenial area	New Canals	4,49,881
The non-perenial area	,,	58,916
Lift area	,,	27,570
Total	,,	5,36,367
Extension of old area		5,40,790

(According to the map supplied by the Executive Engineer, Delta Division, Bhubaneswar).

TABLE NO. 7

Crops to be irrigated by the Hirakud Dam Project

Crops	*In percentage of irrigation area*
Kharif	
Paddy	70
Sugarcane	10
Cotton	5
Other crops	15
Rabi Crops	
Wheat	25
Other rabi crops	17½

(Vide Mahanadi Valley Development, Hirakud Dam Project, Government of India, C.W.I.N.C., pp. 51)

TABLE NO. 8

Rainfall distribution in Mahanadi Delta
(Figures are in inches)

No. of Stations	*Winter (Dec.—Feb.)*	*Summer (Mar.—May)*	*Monsoon (June—Sep.)*	*Autumn (Oct.—Nov.)*	*Total*
12	1.80	6.30	43.98	8.37	60.45

(Vide Irrigation in the Mahanadi Delta, Indian Geographical Journal, Madras, December, 1954) Published by the Author.

TABLE NO. 9

Area irrigated by Mahanadi Divn.

Subdivisions	*Long lease*	*Seasonal lease*	*Area under command*
Jagatsingpur	71,542	1,634	2,00,632
Kendrapara	43,410	931	95,475
Kendapatna	59,502	1,854	73,637
Jobra	24,893	90	44,637
Total	1,99,347	4,503	4,14,381

(Figure are of 1952-53, unpublished data. Collected from Government sources)

TABLE NO. 10.

Details of canals system of the Mahanadi System

Canals	*Length of the canals (in miles)*	*Length of the distributaries (in miles)*	*Area under gross command (in acres)*	*Area irrigated (in acres)* 1950	1952-53
Kendrapara (Navigable)	39	370	..	67,000	67,318
Kendapatna Extension (Navigable)	16	..	116,099	..	..
Gobari (Navigable)	15.5	25		6,000	5,681
Gobari Extension. (Navigable)	6	17	13,534	3,000	3,268
Talandanda (Navigable)	52	110	65,179	24,000	23,668
Patamundai (Navigable)	47	116	57,997	25,000	26,413
H.L.C.R.I. (Navigable)	33	134	..	..	24,858
Machha Goen (Not Navigable)	39	241	1,27,696	43,000	46,096

(Vide Irrigation in the Mahanadi Delta, Published by the author in the Indian Georgaphical Journal, Madras, December, 1954)

TABLE NO. 11.

Cultivation and irrigation

Revenue thana	*Irrigated or not*	*Density of population (per sq. mile)*	*Intensity of paddy cultivation (In %)*	*Precentage of cropped to the total area cultivated*	*Percapita cultivated land (in acres)*	*Average size of the cultivated plots (in acres)*
Cuttack	Irrigated	839.9	80.4	19.55	0.333	0.26
Salepur	,,	847.2	64.7	27.52	0.484	0.16
Jagatsingpur	,,	898.7	73.4	26.27	0.513	0.18
Tritol	,,	517.6	87.9	2.59	0.657	—
Kendrapara	,,	847.7	69.5	20.33	0.559	0.23
Patamundai	Partly irrigated	429.2	86.1	8.03	0.956	0.27
Puri	Not Irrigated	339.7	73.7	8.63	0.643	0.47
Gop	,,	549.5	87.4	7.45	0.633	0.82
Pipli	,,	719.9	89.1	32.55	0.652	0.34

(Vide Irrigation in the Mahanadi Delta, Indian Geographical Journal, Madras, December, 1954. Published by the author)

TABLE NO. 12.

Irrigation and double cropping
(areas in acres)

Revenue thana	*Irrigated or unirigated*	*Total cropped area*	*Double cropped*	*Precentage of double cropped area to the total area cultivated.*	*Rabi*
Cuttack	Irrigated	88,377	17,278	19.55	23,268
Salipur	,,	1,24,140	34,170	27.52	36,755
Jagatsingpur	,,	1,71,303	45,009	26.27	48,111
Trital	,,	1,36,650	13,112	9.59	14,048
Kendrapara	,,	1,48,504	30,202	20.33	33,638
Patamundai	Irrigated partly	1,04,925	8,523	8.12	15,869
Puri	Non Irrigated	1,88,162	16,440	8.63	30,940
Gop	,,	97,599	7,282	7.45	10,413
Pipli	,,	1,83,420	59,715	32.55	62,858

(Vide Irrigation in the Mahahadi Delta, Indian Geographical Journal, Madras December 1945. Published by the Author)

TABLE NO. 13.

Region	*Percent of the total area under cultivation*	*Percent of the total area under paddy cultivation*	*Percentage of the total area under irrigation*
Mahanadi Delta.	79.9	60.3	10.4

(Vide Irrigation in the Mahanadi Delta, Indian Geographical Journal, Madras, December, 1954. Published by the author).

TABLE NO. 14.

Trend in area irrigated by the Mahanadi system
(Figures are in acres)

Year	*Long term lease*	*Season lease*	*Other leases*	*Total*	*Increase or decrease*
1947-48	....	4,812	....	1,92,791	....
1948-49	1,92,837	4,812	10	1,97,659	4,868
1949-50	1,92,603	4,850	96	1,97,549	110
1950-51	1,95,820	8,714	4	2,04,538	6,989
1951-52	1,97,255	6,628	128	2,04,011	527
1952-53	1,98,173	4,503	18	2,02,694	1,017

(Unpublished data collected from Government sources)

TABLE NO. 15.

Rainfall and irrigation

Year	*Rainfall in inches*		*Total (in inches)*	*Increase or decrease*	
	Kharif	*Rabi*		*Rainfall in Kharif season*	*Long term leases (in acres)*
1948-49	40.00	3.01	41.01	....	....
1949-50	41.04	0.32	41.36	1.04	234
1950-51	50.47	8.29	58.76	9.43	3,223
1951-52	40.93	3.33	44.26	9.54	1,435
1952-53	41.15	0.88	41.03	0.78	1,078

Average of 14 rainfall stations which come under the jurisdiction of the Mahanadi Division has been considered unpublished data from Government sources.

TABLE NO. 16.

The Baitarani Cnanal system

Canals	*Length Canals (Miles)*	*Length of the distributaries*	*Area irrigated (acres)*
High Level Canal Range III	16	54	27,000
Jaipur (navigable)	6	86	19,000
Total	22	140	46,000

(Vide Orissa 1949. Page 69)

TABLE NO. 17.

Efficiency of canal system in Orissa

Canal Systems	*Total length (Miles)*	*Irrigation per mile of canals (in acres)*	*Person affected per mile of canal system*
Rushikulya system	303—2	314.8	2,115
Hirakud system (proposed)	589—0	1,151.1	1,374
Delta Division (proposed)	641—0	1,680.4	1,440
Mahanadi Division	242—0[1]	837.5	6,142
	1,260—0[2]	160.8 a/c	1,176
Baitarani system	162—0	284.0	2,567

[1]Navigation, irrigation and branch canals.
[2]Navigation, irrigation, branch canals and distributaries.

TABLE NO. 18.

Discharge of the rivers

Rivers	*Discharge at the head of the delta*	
	Maximum	*Minimum*
Mahanadi	15,71,000	200
Brahmani	6,43,290	130
Baitarani	5,00,000	74

TABBLE NO. 19.

The Minor Irrigation in Orissa

Subdivision	*Year*	*Total expenditure (in .000 of Rs.)*	*Total number of projects*	*Area irrigated (acres in 000)*		*Extra production.*
1	2	3	4	5		6
Cuttack Dist.						
Cuttack ..	1950-55	131.3	34	2.0	2.1	16,864
Jajpur ..	1950-55	346.5	58	0.9	13.8	69,300
Kendrapara ..	1949-54	212.2	50	—	3.6	40,100
Athgarh ..	1950-55	561.8	123	3.3	10.0	45.317
Balasore Dist.						
Balasore ..	1949-52	68.1	32	—	4.1	22,830
Bhadrah ..	1949-54	131.8	23	—	18.5	73,250
Nilgiri ..	1950-52	142.2	69	—	11.7	59,170
Puri Dis.						
Puri ..	1950-55	232.2	37	—	10.5	73,674
Khurda						
Nayagarh ..	1950-55	616.2	188	8.1	31.6	160.720
Sambalpur Dist.						
Sambalpur ..	1949-54	312.4	30	1.3	5.9	43,804
Bargarh ..	1949-54	403.8	39	1.4	9.6	
Deogarh ..	1949-55	205.5	112	—	9.5	82,236
Kuchinda ..	1950-54	287.2	58	0.0	4.0	19,080
Rairakhol ..	1949-54	199.0	47	—	11.7	—
Ganjam Dist.						
Chatrapur	—	—	—	—	—	—
Bahampur	—	—	—	—	—	—
Ghumusar ..	1950-55	378.7	59	1.2	8.6	19.880
Koraput Dist.						
Koraput ..	1949-54	191.4	48	—	3.6	12,861
Nowrangpur ..	1950-54	210.3	34	—	2.3	19,080
Rayagada ..	1950-55	271.6	72	4.6	7.2	1,38,170
Dhenkanal Dist.						
Dhenkanal ..	1949-54	476.0	138	—	34.4	1,70,580
Kamakhyanayar ..	1949-54	462.9	103	9.0	19.7	1,96,287
Talcher ..	1949-51	224.0	276	—	5.3	6,652
Patlahara ..	1949-54	596.9	111	3.9	20.7	2,30,993
Athmallik ..	1949-54	354.1	130	3.5	9.8	85,948
Hindal ..	1949-54	745.4	89	23.2	31.1	3,15,550
Angal ..	1949-54	392.9	90	—	16.4	19,748

TABLE NO. 19—*contd*

1	2	3	4	5		6
Keonjhar Dist.						
Keonjhar ..	1949-54	331.7	60	—	—	—
Champua ..	1950-55	434.3	56	3.5	4.2	—
Anandapur ..	1950-55	211.0	31	1.3	5.6	57,880
Phulbani Dist.						
Kandmal ..	1949-54	53.5	21	0.7	1.3	—
Baudh ..	1949-54	509.5	124	2.5	19.0	—
Balliguda ..	1949-54	84.8	—	0.2	3.2	—
Balangir Dist.						
Balangri ..	1949-54	575.8	57	1.9	6.5	—
Tiflagarh ..	1950-54	376.4	26	0.5	12.0	1,10,231
Patnagarh ..	1950-54	287.2	34	0.0	4.0	19,080
Sonepur ..	1949-54	396.3	68	—	26.6	59,883
Sundargarh Dist.						
Sundargarh ..	1951-55	635.0	46	1.5	16.7	66,105
Panposh ..	1950-54	136.6	35	—	7.1	350
Bonai ..	1950-55	503.7	47	0.8	20.0	86,069
Kalahandi Dist.						
Kalahandi ..	1950-54	159.4	23	—	9.3	27,900
Dharamagarh ..	1949-55	68.9	8	0.2	0.8	4,440
Nawapara ..	1950-55	329.6	50	0.5	4.8	15,160
Mayurbhanj Dist.						
Baripada ..	1949-54	449.5	146	—	28.6	—
Bamanghaty ..	1949-55	293.5	94	20.1	33.9	13,677
Panchipir ..	1949-54	387.0	117	—	17.3	—
Kaplipada ..	1949-55	357.1	117	2.3	13.2	24,789

TABLE NO. 20

The medium and minor irrigation

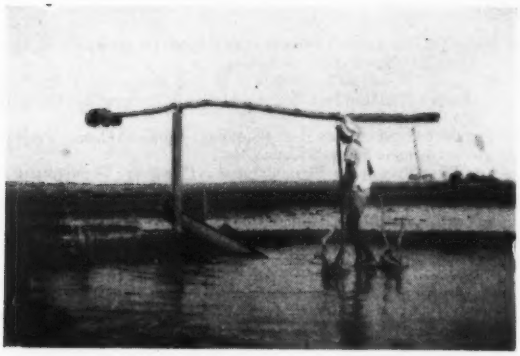
Year	*Total amount spent (in lakhs of rupees*			*Area irrigated (in acres)*		
	Medium	*Minor*	*Total*	*Medium*	*Minor*	*Total*
1951-52	28.82	38.40	67.22	27,000	160,000	187,000
1952-53	15.00	38.19	53.19	31,000	96,000	127,000
1953-54	15.00	45.00	60.00	22,000	—	22,000
1954-55	25.22	40.00	65.22	50,000[1]		50,000
1955-56	17.14	40.00	57.14			
Total.	101.18	201.59	302.77	130,000	256,000	386,000

[1]With a further expenditure of 42 lakhs.

TABLE NO. 21

Year.	*Area irrigated by minor irrigation (in acres)*	*Extra yield in maunds*	*Estimated cost (in rupees)*
1949-50	1,190	9,956	66,102
1950-51	4,746	40,267	69,070
1951-52[1]	7,110	23,000	60,423

[1]Figures for Puri District are not available.
(Vide Irrigation in the Mahanadi Delta, Indian Geographical Journal, Madras, December 1954. Published by the author)



The lift irrigation in the lower reaches of the delta where sub-soil water table is sufficiently high for the use of this method (Janta).—*Photo by N. Prusti*

During the past half a decade (1951-55) or in other words during the First Five Year plan period 386,000 acres of land has been brought under irrigation with an estimated expenditure of 300 lakhs of rupees (for details vide Tables No. 19 & 20). The detailed treatment of two areas with completely different morphological features will present a vivid picture of the varied types of practices that are followed.

(*a*) The minor irrigation in the Mahanadi delta :
Minor Irrigation
(*i*) Tank irrigation
(*ii*) Well irrigation.
(*iii*) Irrigation by other native methods.

Minor Irrigation : (As examples)
(*a*) *In the Mahanadi Delta*

In the non-canalised areas of the Mahanadi Delta, the minor irrigation is of greater importance. In the year 1950-51 the total acerage irrigated by the minor irrigation works was 4,746 acres which resulted in an extra yield of 40,267 maunds and in the year 1951-1952 the total area irrigated by the minor irrigation shot upto 7,110 acres. (vide Table No. 21).

Thus the minor irrigation is gaining more ground in the agriculture of the area. Besides these main types of minor irrigation there are many other native types which are scattered throughout the Delta. The 'Janta,' 'Sena,' 'Souda' and 'Tenda' are widely used in the remote corners of the rural areas. Of all these, the Janta is more popularly used in the lower reaches of the delta where the sources of water are not far below the general level of the ground. There exists a strange relation between the underground water level and the utility of these means of lifting water to the paddy fields. The use of the Janta for lifting water and draining the marshy lands near the lagoon areas of the Puri Sadar Sub-division is a popular sight. But as the water-table falls down in the upper reaches of the Delta, the use of Janta becomes rare, and it is gradually replaced by the 'Sena' and 'Tenda' only because by the help of these indigenous tools, water can successfully be lifted without much cost from lower levels.

(*b*) *The Jira and Jhaun Basins*

The importance of irrigation cannot be overemphasised, especially in this region. Utmost care and economy are observed in using every source of water. It is of great importance not only because of of the lack of rain water during the winter and premonsoon days but also due to a hard non-porous top soil which helps the surface run-off and hence only a very little proportion of the total annual precipitation percolates. In summer the subsoil water level falls considerably low and small wells locally known as Bercha or Chuan dry up. The local streams and the rivers are seasonal in character and hence they serve very little as source of irrigation. The terminology for the local sources of water supply is very rich and each individual type has got its own name. The terms vary according to their type and size, but on a broad basis the entire irrigation system falls into two divisions :

(1) The lift irrigation.
(2) The gravity or flow irrigation.

The lift irrigation

Well irrigation comes under the purview of the lift irrigation. As mentioned earlier these wells are locally known as Chuan and they are widely scattered over the cultivated fields. Yet a peculiar trend is marked in that they are mostly confined to the Mal, Berna and Bahal (medium and low level) types of lands as the underground water table is reached at comparatively lower depths. The optimum capacity of irrigation from each welll is three to five acres.

The gravity or flow irrigation

By gravity of flow irrigation water is kept reserved by artificial embankments and small canals are cut from it. The undulating Gondwana topography helps in forming natural depression with a hard and compact subsoil, which indirectly helps the storage of water. Those water bodies are scattered all round the village area and are mainly confined to high lands (vide Map No. 7). According to their size they are called Bund (a tank with high embankments on all the four sides), Kata (only one high embankment across a natural depression) and Munda (comparatively smaller in size). Amongst all these three types of water bodies Kata is more frequent than others and at times their size is upto several hundreds of acres.[22]

The rivers and streams as they are tributaries of the Mahanadi in the upper Mahanadi catchment basin have steeper long-profiles and hence their torrential flow during the monsoon months often hinder the communication, but during the late monsoon months and in the winter when the dearth of water is keenly felt, they dry up and expose their sandy and gravel beds. Thus they present seemingly insurmountable hurdles for tapping the water from the river beds and they serve but very little purpose for irrigation.

Besides all these irrigation water plays a dominant role in the classification of land types as it controls the fertility and productivity of the land [23].

Conclusion

In concluding remarks we like to draw the attention of the authorities concerned to the fact that the need of a co-ordinated irrigation plan (both major and minor irrigation projects) in the light of the previous discussion will be of great benefit for the economic betterment of Orissa and the speedy implementation the existing schemes is also of a dire necessity.

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6. The Mahanadi Valley Development, Hirakud Dam Project, Government of India C.W.I.N.C.
7. The First Five Year Plan, Cabinet (Planning) Department of Orissa.

References

1. For official administration it is called the Delta Division.

2. For official information it is called the Mahanadi Division.

3. Brahamani system.

4. Was originally called Bavancona reservoir
   At present Ruselkonda is known as Bhanganagar

5. Exclusion of 3,397 acres commanded by Gallery channel and Russelkonda reservoir and 8,000 acres proposed to be commanded by the Grisolla channel.

6. Ghumusar taluk

Government Villages	12,643 acres
Inam Villages	853
	13,496

Berhampur taluk :

Government villages	72,000
Inam villages	8,650
Zamindary villages	23,100
	117,246

7. Area estimated by the collector :

Ghumusar taluk	17,460
Berhampur taluk	71,496
Aska (Zamindary-inam)	17,181
	106,300 acres

8. The average annual profit about Rs. 1 lakh (excluding interest charges on capital) but a loss of Rs. 88,000/- of interest charges are taken into account on the capital expenditure of Rs. 56 lakhs —Vide pp. Orissa 1949, pp. 71.

9. Gross storage capacity 6.60 M.A. feet
   Dead storage capacity at 590.00 1.88. M.A. feet
   Live storage 4.72. M.A. feet

   The first five year plan, Govt. of Orissa pp. 18.

10. Suggested by the writer in a paper on 'Agronomy in Jira and Jhaun basins' published in Geographical Review of India, March, 1954.

11. Minimum discharge— 1,000 cusecs (before completion)
    ,, ,, — 8,800 ,, (after completion)

    (Mahanadi valley development, Hirakud Dam Project, June 1947) Government of India, Central Water Ways, Irrigation and Navigation Commission pp. 19)

12. The first five year plan, Orissa, Cabinet (planning) Department pp. 221.

13. Additional yield per acre :

Bahal	4	mds
Berna	5	,,
Mal	8	,,
At	10	,,

    Additional yield of rabi ;
    12 mds, in the Bolangir and Sambalpur districts and therefore 45 lakh maunds in those areas.
    In delta area 5 mds. per acre
    In rabi area 12 mds per acre

    So from the delta 50 lakh maunds a year. Hence grand total will be 95 lakh maunds.

14. Sir Arthur Cotton visited Orissa in 1858 to give some advice regarding the flood control in Orissa and just after two years, in the year 1860, the work of canal contruction was started by the East India Irrigation and Canal Company.

15. Khariff season —July-October
    Rabi season —November-February

16. Average of 14 rainfall stations which come under the jurisdiction of the Mahanadi division collected by field work.

17. The capital amount was Rs. 2,71,143 (Government of India has taken the burden of the original capital charges and interest and the system now works on its own, free from these charges. Water rates and miscellaneous leases on canal property is about Rs. 5 lakhs and the navigation receipts Rs. 147,000.

18. Rs. 300 lakhs have been allotted diring the First Five Year Plan for minor and medium irrigational schemes of which 200 lakhs are exclusively for minor irrigation purposes. The First Five Year Plan—Orissa PP. 60.

19. New tanks excavation—33%
    Old tanks renovation—25%

    (Vide Note on Financial assistance irrigation works under the intensive cultivation schemes submitted to the Government of Orissa by the Secretary Development Department)—Manuscript.

20. Private projects—a project which benefits an individual or a very small group of persons and can be divided into (1) surface wells (2) Tube wells (3) Tanks, bunds etc.

    Public project—a project which benefits a large number of persons either belonging to one village or more than one village.

21. First Five Year Plan, Orissa—PP. 64.

22. Bundly—Bund in a diminutive form.
    Nada —Small Munda is called a Nada.

23. Irrigated lands classified Pani, Berchhapani, Badi-Khari-Pani, Berchha-Khari-Pani.

    Water bodies classified River, Nala
    Tanbari classified Bund, Bundly, Kata Moda, Chaun, Jala-Magna.

Rural Electrification

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In the scheme of balanced development of the country which aims at raising the national income and standard of living of the people it is necessary to pay due attention to the development of rural areas where 80% of the population live. Establishing Cottage and small Scale Industries, resuscitating those in existance, improving methods of irrigation and agriculture in the rural areas will prouduce greater wealth and find more opportunities for employment to the agriculturists during the off season. This will also prevent population exodus from villages to urban areas. The most effective way of achieving the above objects of modernising agriculture and developing the industrial potentialities in rural areas is by making electricity available at the door steps. Hence the importance of Rural Electrification.

Load Survey

Assessing the power requirements in villages and groups of villages is a tricky job. Load demands are often scattered and small. People are poor and unaware of the resulting benefits. Development of load during a particular period, say 10 years, will depend on various factors, like

(1) the population and economic standard of the people in the area,

(2) the intensity of developmental activities in the fields of industries, commerce and agriculture in the locality,

(3) income of local body, if any,

(4) agriculture and forest produce suitable for processing raw materials available in the area for setting up Cottage of Small/Medium Scale Industry,

(5) depth of water strata and annual rainfall,

(6) means of communication and transport facility to the consuming centres and District/Divisional headquarters,

(7) irrigation facilities available.

The Surveyor has also to study the annual increment in the consumption of energy in other parts of the country based on the last 10 years or more, the rate of growth of energy consumption for each category of load on all India basis for the same period in similar areas, other data related to villages in some selected States which have been electrified earlier depicting average conditions and showing annual average growth in respect of number of consumers, per capita consumption of general and domestic load, overall per capita consumption due to all categories of load. Also of interest will be information of the percentage of population enjoying power facilities in electrified rural are as related to the period.

The Surveyor will have to contact the representatives of the people in the area, local school and other Government authorities, owners of lands, plantations and industries for determining their requirements of power. After all the information outlined above are gathered, this is sifted and load is divided into the following categories :

(*a*) Residential load (lighting, heating etc.)

(*b*) Street lighting,

(*c*) Agricultural pumping,

(*d*) Small and Cottage Industries (some of which may be firm or seasonal).

The demand factor for different types of load are assumed and considering diversity of loads, the maximum demands are arrived at. However, the regional peculiarities and inherent resistance of people to change have necessarily to be taken into consideration. For instance houses in villages in Orissa have thatched roofs even though the owner is prosperous as he utilises straw from his land for thatching every year which keeps the house cool in hot weather. These houses cannot be omitted from the list of potential lighting, etc. loads.

Overall load survey of the State has been carried out by the Central Water & Power Commission and detailed surveys by the State Electricity Department based on which electrification schemes have been framed and executed.

Load survey data of a typical village in Orissa can be seen at Appendix I.

Rural Industry

There are various ways of profitably utilising electric power in rural areas to give maximum returns and without the attendant evils of large scale mechanisation. In fact the social, sanitary and labour problems which yet remain unsolved in large industrial towns and its suburbs will be minimised to an extent.

One of the main rural loads will be Agricultural pumping and dewatering. Lift irrigation for cultivation by utilising electric power during periods of the night when demand on the power station is lesser is profitable both to the agriculturist and the supplier in that the former gets concessional tariffs and the latter gets diversity in the loads and runs the generating station economically. Lift irrigation in the State of Orissa has been proposed on a large scale from Hirakud Power System in Sambalpur area in Orissa. Also possibilities exist for lift irrigation in the sugar growing areas along the Baghua and Dhanai rivers, Aska area, Ghumsur along Badanadi and Pandiya to Patrapur from Rushikulya river at the confluence of Khankhai and Rushikulya. Some of the possibilities are under investigation, where sources of underground water exists electrically driven pump-sets bring water to the surface and ensure greater return to the agriculturist with considerable reduction in drudgery. This has not been attempted in Orissa but small pumps are being utilised for lifting water from wells in rural areas.

Processing of agricultural products in villages can be carried out efficiently by small electrically driven machines. For instance oil extraction is done by animal labour which is uneconomical due to the fact that much oil is left in the seeds. An oil press with a 3 h.p. motor would do a neat job of it. There is belmetal industry in villages like, Balakati, Kontilo, Remuna etc. run on small scale using manual labour only. There is good demand for these products. Utilising small electric motor drives and some improved tools coupled with existing experience of the workers will result in better production at reduced rates. Power requirements for different small industries (as given by Central Water & Power Commission) can be seem fron Appendix II.

Orissa being rich in forest wealth, sizing timber, wood turning and furniture making can be achieved in villages with a small capital outlay. Most of the the people who are dependent on agriculture are busy only during a part of the year, particularly in this State where only one crop is raised in the year. Also introduction of improved methods of agricultural, and this is inevitable, will render some of the agricultural labour surplus. Cottage industries for both the above categories with the help of electricity are given below :

1.	Silk Reeling	$\frac{1}{2}$ H.P.
2.	Tape weaving	$\frac{1}{2}$ H.P.
3.	Machine Knitting	$\frac{1}{3}$ H.P.
4.	Button making.	$\frac{1}{2}$ H.P.
5.	Coir industries.	$\frac{1}{2}$ H.P.
6.	Wooden Toy making	$\frac{1}{2}$ H.P.
7.	Small machine shops.	3 H.P.
8.	Weaving on industrial power looms.	$\frac{1}{2}$ H.P.
9.	Carding of wool	3 H.P.
10.	Belmetal industry	$\frac{3}{4}$ H.P.

Most of these industries require from $\frac{1}{3}$ to $\frac{3}{4}$ H.P. and the running cost of all the machines is small. In big villages or group of small villages power looms can be used to give increased production 3-4 times, thus enabling the weaver to keep pace with competitive market and also get better income. This industry can develop on co-operative basis as capital outlay is about Rs. 6,000 per loom.

It is also learnt that using electric drive for the Ambar Charkha is acceptable on principle to the advocates of hand operation of the same.

Economics

Rural Electrification Schemes, by themselves, are uneconomical and in majority of cases they are not self supporting even in 10 years time. This is due to the high capital cost and running expenditure of the rural schemes and the rather slow load development ; also the tariffs have to be reasonably low to be within the means of the average villager with moderate means. But the overall benefits to the people by way of increased production, accelerated industrialisation more employment etc. outweigh the financial considerations as directly affecting the scheme. It is here that subsidising such schemes by Government will be necessary. Also profits over reasonable return of urban area electrifications should be made available for rural development.

It should be the endeavour of the engineer to do his best in reducing the capital cost on rural schemes. These can be achieved by (*i*) simplifying the design of the generating stations, substations etc. (*ii*) relaxing the rather rigid electricity rules (*iii*) using all aluminimum conductors instead of copper (*iv*) using wood poles or prestressed concrete poles instead of rail poles (*v*) simplifying protective system.

Buildings and structures should not be very massive but must be utility type with asbestos sheet roofing. The substations can invariably be of outdoor type with pole mounted transformers protected by H.T. cut-out fuses. The line supports can be of sal wood, treated for longer life. The minimum clearance to ground of the line conductors which is to be 18′ as per revised Electricity Rules can be further reduced to 15′ in the case of L.T. lines as per the practice, in U.S.A. or Canada. The cost of copper conductors being very high, all aluminum conductors can be used both for distribution lines and service lines. In this connection it may be pointed out that single phase lines, use of steel conductors and use of ground return instead of metallic conductors are being made by many undertakings in Canada. Transmission line to the village need only be (in most cases) a single phase 11 or 33 kV line and stepped down by a transformer of suitable capacity. Manufacturers are giving and can keep transformers of standard capacities for single phase transformation from 11 kV/230 V and 33 kV/230 V upto say 100 kVA and without any tappings. The factor of safety for metal poles which is now 2 can be further reduced, to say 1.5. for rural lines and that for wood poles which is 3.5 can be reduced, to say 2.5. for rural lines. Similarly less costly types of insulators, say of tough glass, may be used. It is also necessary to standardise all materials, crossarms, transformer capacities etc. so that least loss of time and labour in execution is experienced and standard spares located at a central station. Thus

it will be seen that by suitably simplifying designs, relaxing some rules without unduly jeopardising safety conditions, using indigenous materials, raw and manufactured, it will be possible to reduce capital outlay compared to orthodox methods by about 30% overall. Many of the ideas expressed above have been successfully tried in this State while executing works departmentally.

With a view to accelerate load building in rural areas there is necessity in our country of intensive propaganda regarding the use of and benefits from electricity, particularly in the are as served by multi-purpose projects. Some of the methods that can be adopted are (1) setting up demonstration centres to indicate the actual working of electrical appliances, their capital and running costs with its relation to the finished product, (2) propaganda vans to distribute illustrated pamphlets and explain to the villagers in their own language and where possible show sound films. (3) sale of equipment on hire purchase system recovering the amount in easy instalments (4) making available maintenance service and expert advice.

The rates of supply of power for agricultural pumping loads and small industries has a great bearing on attracting consumers in rural areas. The Small Scale Industries Board have suggested to Governments that concessional rates of energy will have to be given to small scale industries at about as -/1/6 per unit. The net rates as proposed for hydro power supply and those from existing thermal and diesel stations in this State are given below :—

TARIFF RATE

For Small Industries & Agricultural Pumping

	Small industries	*Agricultural pumping*
I. Deisel.	*5 H.P. and above.* -/4/- per unit and rebate six pies if paid within 10 days.	-/4/- per kWh of rebate six pies.
II. Thermal.	*Upto 50 kW maximum demand.*	
	1 (*a*) Rs. 5/- per month per BHP installed plus	/2/6 subject to rebate of three pies if bill paid within 10 days.
	(*a*) energy charge of -/3/- per unit subject to rebate of six pies if bill paid within 10 days.	
	Alternatively	
	2. -/3/3 per unit subject to rebate of 3 pies per unit if paid within 10 days. Provided a minimum of Rs. 5/- per month per BHP is guaranteed.	
III. Hydro rate.	1. From 3 kW to 20 kW at 400 V—3 phase.	For supply at 400 V —3 phase. 1.5 per kWh for 1st 500 kWh per month.
	1.5 as. per kWh for 1st 1000 kWh per month.	1.25 as. per kWh for all over 500 kWh per month.
	1.25 as. per kWh for all in excess of 1000 kWH per months subject to a monthly minimum charge of Rs. 4/- per BHP and connected load.	subject to a minimum of Rs. 48/- per BHP per per annum.
	2. for seasonal industries the charge should be reckoned annually at Rs. 48 per BHP per annum.	
	3. for supply restricted to the period 10 p.m. to 8 a.m.	
	0.75 as. per kWh subject to the minimum charge as in 1 above.	

The State Government have approved a maximum rate of -/2/- at 11 kV and 2.2 at medium tension per unit of electricity supplied to industry from diesel, thermal or hydel stations, where the prevailing rate is lower than this the lower rate will apply.

The expenditure in this State on Rural Electrification during 1st plan period is about 59 lakhs and 36 small towns and groups of villages have been electrified. The proposed expenditure during 2nd plan period is 150 lakhs and about 200 groups of villages are expected to be electrified. Besides these certain number of villages are provide with electricity under other schemes and projects in operation in the State.

Thus, it will be seen that rural electrification poses the problems of economic methods of erecting rural power stations, substations, transmission lines and equipment, of finding funds for the same, of building up load in rural areas by suitable methods of propagating and educating the villagers regarding electricity, of organising multipurpose co-operatives of the people with a view to develop agriculture and industry, in short assist the villager to shed his apathy to change and bring to him the message of hope and progress of modern science. The engineer has to tackle all these problems with an ultimate success. Let not those in the villages keep looking any more with longing eye, let them share with their brethren in the towns all the prosperity that ahead lie.

APPENDIX I

(Load survey data of a typical village in Orissa)

State—Orissa.
District—Balasore.
Tahsil—Balasore Sadar.

1. Town or village—Soro (village).
2. Civic Authority—Soro Gram Panchayat.
3. Population 1951—6,700
4. Area in sq. miles—4 sq. miles.
5. Length of streets—4 miles.
6. Annual income of local civic body—Rs. 5,000/- to Rs. 6,000/-
7. No of houses—Pucca—150 nos,. Kutcha—1,350 nos.
8. No. of villages likely to be electrified in 5 years—150-200
9. No. of shops—
10. No of street lights—oil or gas—Panchayat had 32 kerosine lamps. They are not lighted now.
11. Annual expenditure as street light—
12. No. of electric street lights likely in the 1st Five Year—35 nos.
13. Spring water level in feet.—15 ft—20ft.
14. Annual expenditure on water supply—

15. Expected water supply load by 5th year—
16. Existing industrial loads—

(*a*) Ricemill—driven by steam engine	working 6 hours a day	All the year.	27 BHP	Since 2 years.
(*b*) Oil ghani Diesel Engine Attachaki.	—do—	—do—	40	3 years.
(*c*) Foundry & Rolling Mill. Steam Engine	—do—	—do—	50	5 years.
(*d*) Rice Mill —do—	—do—	—do—	30	5 years.
(*e*) Rice Mill. —do—	—do—	—do—	27	3 years.
(*f*) Cinema Diesel Engine.	—do—	—do—	15	3 years.

17. Prospective Industries.
Rice Hullers. 60 H.P. 6 hours. a day All the year.
18. Existing cottage industries likely to be converted to Electric Drive :— Nil.
19. Irrigation data :— (*a*) Spring water line—15 ft.—20 ft.
(*b*) Particulars of nearby river or nullah—Nil
(*c*) Rate of water for canal irrigation—
20. Irrigation arrangements :— (*a*) Existing—Nil
(*b*) Proposed—Panchayat has applied for a diesel pump which will be given to cultivators on hire.
21. Any other scheme regarding power e.g. dewatering, Railway load etc.

Rs. 40,000 have been provided for electrification of Soro in Balasore Thermal Scheme by providing 33 HT tap off line from existing line and a substation 33/4 kV 100 kVA substation at Soro. The cost includes the L.T. distribution lines etc. complete.

APPENDIX II

(Power requirments for different small industries (C.W.P.C.)

1. Rice Hullers	—size 8—3 H.P.
	—size 4—5 H.P.
	—size 2—10 H.P.
2. Rice Hullers & Polisher—large	—25 H. P.
3. Cotton ginning—single roller	—3.5 H.P.
double roller	—5 H.P.
4. Carding	—2.3 H.P.
5. Flour mill—Vertical type	—5-7. 5 H.P.
Horizontal type	—10-15 H.P.
6. Oil Extraction Press.	—3 H.P.
7. Expeller Baby type	—10 H.P.
Standard type	—12.5—15 H.P.
8. Saw Mill	—7.5-15 H.P.
9. Cinema—With lighting	—15 H.P.
without lighting.	—10 H.P.
10. Ice factories. 2 tons.	—12 H.P.
5 tons.	—25 H.P.
10 tons.	—45 H.P.
20 tons.	—80 H.P.
11. Small workshop (drill, lathes and grinders).	—7.5 H.P.
12. Foundry blower.	—2.5 H.P.
13. Ice candy Plant (compressor and pumping).	—5 H.P.

APPENDIX III.

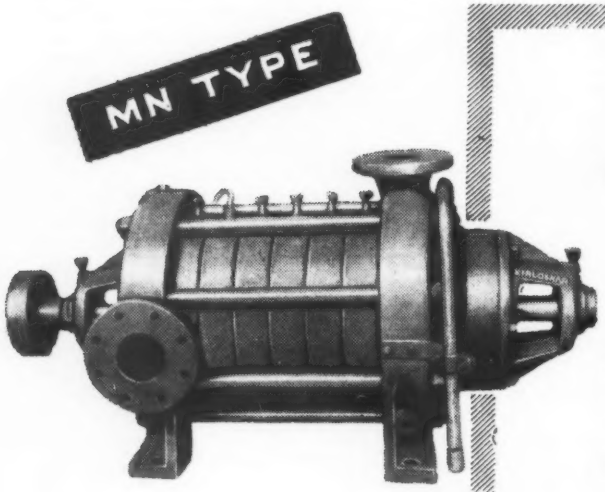
(for farm use).

Devices with built in motors.

1. Drying machine.	1.0 kW.
2. Micher.	0.75 kW.
3. Cream separator.	0.37 kW.
4. Refrigerator.	0.12 kW.
5. Milk cooler.	1.47 kW.
6. Threshing mill.	15.0 kW.

By means of 4 kW motor and 2 portable motors of 2.2 kW each following operations can be carried with a total power of 8.4 8.4 kW.

1. Threshing.
2. Mincing of fodder.
3. Rough grinding of corn.
4. Manure—Pumping.
5. Manure—Stiring.
6. Milling.
7. Potato—sorting.
8. Water pumping.
9. Grinding.
10. Turrip topping.
11. Hay bailing.
12. Fruit pressing.



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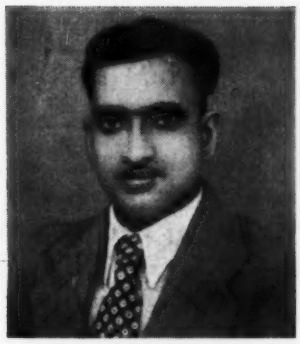
Electrical Development in Ganjam District of Orissa



By S. M. PANDA, *Executive Engineer, Department of Electricity, Government of Orissa*

The Five Year Plans aim at balanced development of all sectors of economy with a view to increasing the per capita income of our people who have been known to be poor for generations. To achieve this aim various power projects have been taken up and they are coming to a successful completion one by one. Machkund Hydro Electric Scheme which is one of such power projects was started in 1947 in the enthralling atmosphere of a free country and its second generating set has already been commissioned. Installation of another set is in progress. The power generated is being shared by the States of Orissa and Andhra.

The District

In Orissa, the district of Ganjam and some adjoining areas are the most important regions to be benefited by the Machkund Hydro Electric Scheme. Full of natural beauties, this district contains a good number of big villages with great potency for development. When Orissa was independent, history records, most of these places were quite famous and prosperous. Apart from development of art and culture for which this region had unique contribution, there were flourishing coastal trades and multifarious village industries. As such, availability of electricity which is the forerunner of modern civilisation in such an area will certainly go a long way in achieving the results aimed at.

Load Possibility

It has been thought that villages and towns having a population of 2000 and above will be electrified at the first instant. Accordingly, when load survey was carried out, it was seen that there are about 60 villages who claim to have a population of more than 2000. And the people are very anxious to have electric power. Apart from domestic lighting, the people of their own accord are eager to start new industries. The industries that are already existing are chiefly :—

(*ii*) Rice mills at Aska, Berhampur, Bhanjanagar, Boirani etc.

(*ii*) Saw mills at Bhanjanagar, Berhampur, Hinjilikut etc.

(*iii*) Sugar mill at Aska.

(*iv*) Keura industry in coastal areas.

(*v*) Oil mills at Aska, Boirani etc.

It is to be noted that one Bharat Vegetable Products Factory at Chatrapur has closed down recently due to financial difficulties. It may be expected to revive. When hydel power will be available at a cheaper rate all the above cited industries will be increasing their volume of trade. In addition to these, there are possibilities of starting of the following industries, as necessary skilled hands and raw materials are easily available :

(1) Spinning Mill.
(2) Chemical Industry.
(3) Paper Mill.
(4) Jute Mill.
(5) Organisation of Keura Industries on a bigger scale.
(6) Boat building Industry.

People have also expressed their desire to start :

(1) Rayon Industry.
(2) Perfumery Industry.
(3) Bone Meal Industry.
(4) Bellmetal Industry, etc.,

With development of bigger industries, many subsidiary one will naturaly, grow.

Another important load possibility is the pumping load for irrigation purpose. Even before the power has been available, people have put their demands to utilise as many as 300 pumps at different places of the district. All these have been discussed threadbare and demand put forth at district level.

Load Development

With a view to help develop industrial and domestic loads, one thermal power station of 750 kW capacity was installed by the Government at Chatrapur in May, 1955. Power is sold at a cheap rate to the Berhampur Electric Supply Corporation who are the licensed suppliers for the town of Berhampur, Gopalpur, Chatrapur and Inchhapur. Recently the Government entered into an agreement with this Corporation who have to purchase more power from the Thermal Station at a special concessional rate. In addition to the above, the Thermal Station is also to supply power to other towns which will be connected by trans-

mission lines. When hydel power will be available from Machkund, thermal power from Chatrapur may not be required. Diesel Stations have also been installed at the following places where thermal power cannot be supplied quickly. These places are—

	Month of electrification
(*a*) Aska.	July, 1953.
(*b*) Boirani.	December, 1954.
(*c*) Surada.	January, 1956.
(*d*) Bhanjanagar.	April, 1956.

In a few months' time the following places will also be electrified :—

(*a*) Purusottampur.

(*b*) Khallikote.

(*c*) Rambha.

(*d*) Humma.

(*e*) Ganjam.

(*f*) Balugaon.

(*g*) Banpur.

(*h*) Tangi.

(*i*) Kaluparaghat.

(*j*) Jaripara.

Purusottampur will be connected to the Aska-Boirani 11 kV line which is under construction. Rambha, Humma and Ganjam will be fed from the 750 kW Thermal Station as stated above by means of 33 kV lines to be charged at present at 11 kV. Balugaon, Banpur, Tangi etc. which are important villages of Puri district can have the benefit of hydel power from Machkund and hence they will soon be supplied with power from Khallikote at present, for early development.

Besides these, there are many other places that are envisaged to be electrified under the 2nd Five Year Plan. Chief among them are:

Digapahandi, Pattapur, Padmanabhapur, Sheragad Dharakot, Mundamarai, Hinjili, Kukudakhandi, Kodala, Polasara, Bellaguntha, Balipadar Jagannathprasad, Chikiti, Jayantipur, Jarada, Surala, Patrapur etc.

Transmission and Distribution Lines

Hydel power will be transmitted from Machkund to Berhampur via Rayagada at 132 kV lines upto Rayagada has received Machkund power.

Preliminary works as regards 132 kV Rayagada Berhampur line are almost over and further works are being taken up. At Berhampur power will be stepped down to 33 kV and 11 kV for sub-transmission lines by means of two 132/33/ 11 kV transformers which will be connected to a common busbar. One 33 kV line will be taken from the 33 kV bus through Chatrapur (District Headquarters) to Tangi along the coastal region for a distance of 71 miles. Big villages such as Rambha, Ganjam, Humma, Khallikote and Balugaon will be electrified enroute.

The 33 kV line has already been constructed between Berhampur and Chatrapur by using 7/.118 ACSR conductors on, but is used at present to transmit power at 11 kV from 750 kW Station at Chatrapur to Berhampur Electric Supply Corporation which takes a bulk supply of about 200 kW. The Chatrapur Rambha portion is almost complete except for the Rusikulya river crossing. Conductor of 7/.118 ACSR on rail has been used. For the remaining length upto Tangi, poles have been erected and the rest of the works will soon be completed.

Poles have been erected for the 11 kV line from Balugaon to Banpur. Other 11 kV extensions will be taken from Tangi to Kaluparaghat and Jaripara and also to Kodala and Polosora. The 33 kV line is also proposed to be extended from Tangi to Ranapur which was one of the ex-State capitals of Orissa. Chandpur, where a T.B. Sanatorium is proposed, will then be fed from this line.

This is the position in brief of the power development in the coastal area. For the development of the interior of the Ganjam District, power will be transmitted from Berhampur to Bhanjanagar at 33 kV via Aska and Bellaguntha for a total lenth of 50 miles. A number of 11 kV tee-lines have been envisaged to be erected to supply power at remote corners of importance. Some of these are—

(*i*) Aska—Boirani—Purusottampur 11 kV line 17 miles. Already 7 miles with conductor H.D.B.C. No. 6 SWG on wooden poles have been strung. (*ii*) Aska—Mundamarai—Dharakote 11 kV line 5.5 miles. (*iii*) Bhanjanagar-Zillundi—Badkodanda kV line 4 miles. (*iv*) Bellaguntha—Jagannathprasad line 11 miles etc. (*v*) Ballipadar—Buguda 11 kV line 6 miles (*vi*) Berhampur—Digapahandi—Padmabahapur—Pattapur 11 kV line 21 miles.

In addition to the above, Machkund power can also be easily supplied to the South Ganjam areas where important places like Jayantipur, Jarada, Surla, Golanthra, Chikiti, Patrapur etc. can have electricity, as stated before. Transmission lines for the areas will soon be decided after ascertaining load conditions in detail.

While reviewing the works so far done and as to what may be done, it is seen that the district of Ganjam has a bright prospect to consume sufficient electric power both domestically and industrially. Even before the schemes are half done, the people have shown eagerness to reap the benefit of electricity at places where the same is available. They have improved their living conditions by taking electricity to their own houses and roads—they have installed electric motors to run their saw mills here and rice mills there—they, now, enjoy a better social gathering with picturesque electric lamps arranged artistically in decoration of a fair or ceremonial arena. All this while bringing modern living conditions to the easy reach of the people, will help them to earn more in better way through extensive industry and improved agriculture. And thereby the aim of increasing national wealth by way of increasing per capita income will be realised.

Our Delhi Letter

(From our own Correspondent)

The Institution of Engineer's general meetings held at the Institution building on Mathura road were characterised by rather unique and unusual pronouncements both by the elected President Mr. Hayat and the Finance Minister Mr. T. T. Krishnamachari. Both of them struck a number of original notes in this critical period of the Second Five Year Plan.

Mr. Hayat's address

Mr. Hayat presented the case for power development in a masterly way. He indicated that the generating capacity of 2.3 million kilowatts at the beginning of the First Five Year Plan has been stepped up to nearly six million kilowatts and it was further planned that this figure be increased to 15 million kilowatts by the end of the Third Five Year Plan. This is a significant increase and India can well be proud of it. On the other hand, the demand for greater power has reached a tempo where it is well nigh impossible for production to keep pace with it. This fact is now so well realized that the familiar opposition of habitual doubters is no longer effective. On the other hand they apologise for their earlier attitude, for their lack of imagination and foresight. The country is now faced with the problem of expansion of the existing facilities for the personnel. There is a united demand from all sides that the earliest possible advantage be taken of the immense potential that exists in the country for the development of hydro electric power. This augurs well for the country's industrial and even agricultural progress.

Many constructive sugestions made by Shri Hayat and Shri T. T. Krishnamachari are well worth remembering. I am happy to say that the opinions expressed by them are much in line with the policy and suggestions advocated by the IJPRVD in their pioneeering efforts over the last seven years.

Finance ministers encouraging lead

Shri Krishnamachari's remarks need to be remembered by the engineering profession all over the country. He stressed that the value of engineers as members of society was never at such a height at any period of our history. The burden on their shoulders demanded that they should be able to transform the country from its backward status to the modern stage in terms of the industrial trends which have made the Western nations great and prosperous.

Some big questions

He made several practical suggestions which are worthy of the attention of all thinking men in India. He illustrated how shortage in engineering personnel was hampering production. For instance Tata Steel were unable to have the engineers needed for expansion of their work. They are going outside the country to obtain the services of consulting firms. They are also recruiting a lot of foregin experts. All this is necessary because without steel how far can we go ? What is the use of labouring on the evolving of Indian Standards for Steel when the commodity itself is not available in the required quantity.

Answers

There is hardly any doubt that there are far too many jobs which can not be filled up due to lack of qualified engineers. The snag is that of emoluments. The minimum salary which is offered to engineers in other countries is about Rs. 800 per month plus two months bonus. In this country we offer them Rs. 300 per month. So we need not feel surprised if the best brains are selecting other professions and leaving the engineering field, At present we are creating a vacuum which only new talant can fill, in the large numbers, which are so urgently needed for the implementation of the development plans of this country.

It has been variously estimated that the shortage in the number of engineers is 20,000. Certain estimates have put the numbers that will be eventually short in the next ten years, at a figure of two lacs for a country of the population and size of India.

This is due to the fact that with the increasing tempo of the country's industrialisation, the need for personnel goes up in a geometrical rather than in an arithmetical proportion.

It is well worth remembering that against the 2,000 and odd engineers who are annually qualifying in this country, Russia is training some 30,000 engineers per year. The numbers of engineers annually trained in New China or in Japan are approximately in the same proportion as in Russia. India has therefore to take serious thought in this matter. What can we do ? There is only one answer. *Training institutions must be opened without the slightest delay.* How are we to get professors and training staff for the new Institutions that must be started ? Obviously they cannot be produced from any where but the existing personnel in the country.

Obligation on technical bodies

This imposes an obligation on all institutions and technical departments that they should be able to decide firmly and implement a programme of lending 20% staff to serve as professors and technicians in government and quasi-Government institutions to be set up for imparting engineering education. Now the usual reply that is given by the heads of departments and ministers to requests for staff is in the negative.

Almost always they find good reasons for refusing to lend their staff because of their own requirements. Such a state of affairs must cease and it must be acknowledged that the highest priority needs to be given to the needs of the country in the matter of teaching institutions in engineering.

Shortage of Technicians

The situation amounts to almost a crisis in technical manpower. Hence quite unusual steps need to be taken to meet the emergency. For this purpose the initiative must come from the engineers themselves. They must shed their inferiority complex and come out from their shells. It is no use that they excel only in the technical field and fail in the practical field of action in administration or public relations level.

It is now a recognized fact that the future progress in this country is bound more with technology than with law and order or even finance. All the other spheres have to so adjust themselves that the proper atmosphere is created for planning, design and execution of well conceived engineering projects which will increse the wealth of the country and lead to better employment and better living conditions.

Technicians as administrative heads of Projects

"I would therefore like to see" said the Finance Minister "that Engineers shed their hesitation and make a bold bid for asserting their demands which are necessary for the execution of the Second Five Year Plan. I will rather have technical leaders to function as heads of Government undertakings in place of those civilians who are only masters of diplomacy and who are primarily specialists in codes for civil service regulations. There should be the fullest readiness on the part of leading engineers to take this new role.

Duties and Responsibilities of Engineers

The other factor that emerged from the deliberations of the annual session was in regard to the duties of engineers themselves in the light of new obligations that were indicated in the Finance Ministers remarks. It is a "must" that only high class work capable of solving problems should be respected and all mediocre approaches should be discouraged. The most suitable men should only be selected for the key positions as on their success depends the welfare of the vast masses of the Indian people who are now awake and quite impatient to cover the gaps which have been allowed to occur in the country's progress due to reasons of colonial dependence in the course of history. *From now on the watch-word for engineers should be quality first and quality last.* If this maxim is followed at all levels it can be asserted with confidence that the rays of hope and achievement will dispel the clouds and darkness of want created during the last 200 years of rather an unprogressive era.

After the conclusion of the meetings there was an "At Home" by the Institution Members in which the senior engineers were able to mix with the younger generation in an atmoshere of cordiality and informality. The annual function proved a great all round success.

The Indian Journal of Power and River Valley Development will keep in close touch with the Institution of Engineers whose leadership is now paying urgent attention to policies indicated by the Journal since its inception.

India ready to adopt good ideas from all quarters

There are indications that India will borrow good ideas irrespective of whether they have been evolved by a capitalist country or by a communist country. In fact there are quite a few acceptable ways of approach evolved in different regions which give us valuable techniques for advancement of the programmes of India's rehabilitation. In our quest and desire to march ahead we can do well by taking advantage of the discoveries of science and new techniques, no matter in which country they have been evolved.

Third Commonwealth Standards Conference :

In conformity with the above premises, India has played the host country to the Commonwealth Standards Organisation by calling their third Five-Yearly Conference in Delhi. This important meeting was attended by nearly all the Commonwealth countries including Pakistan. The inaugural meeting was held in the Central Hall of India's Parliament House and was opened by Morarjee Desai—India's veteran administrator and astute politician whose integrity and firmness are a byword in India for the last many years. Dr. L. C. Verman who is associated as Director with Indian Standards Institute from the day of its birth read a message from Prime Minister Nehru saying that India needed standardisation not only in goods but in private and public life. T. T. Krishnamachari who was in charge of the Indian Standards institute while he was Minister of Commerce and Industry expressed his satisfaction about the special part that India was playing in International standardisation.

In this address to the delegates Mr. Desai mentioned the collaborating team work between manufacturer and techonologist by virtue of which great progress was made by the Indian Standards Institute. He eulogized the efforts of the International organisation as it was giving a strong vitality to the work of standardisation. There were no secrets between countries over the exchange of important data in many special fields. There was increased liaison and flow in voluntary mutual asistance, and a two way relationship amongst the countries of the Commonwealth pool, was emerging. There was no regimentation of ideas and there was a common meeting ground for expression of the Commonwealth points of view which produced worth-while results.

India goes metric

Shri Desai referred to the decision taken by India to go metric. He said that this represented a scientific trend in the country by virtue of which the age-old foot-inch system and rupee and anna system will be replaced by the decimal system. This was a step which India had taken in advance of the other Commonwealth colleagues, yet it was consistant with the intimate understanding and unanimity of ideology that generally prevailed in the entire field of standardisation.

Our Steel Shortage

Mr Desai then referred to the problem of steel in India. The deficiency in steel production acted as a bottle-neck in all the construction projects in India whether it be Housing or River Valley projects or Roads or Railways. India had therefore decided to increase her steel production several fold. But production alone will not solve India's problems. A better utilization of available resources was equally important.

Continued on page 24

Irrigation and Power Development in Orissa

Ever since the Province of Orissa had been created, it was considered a backward and undeveloped area. But with the achievement of independence, the rapid strides that this State is making is breath-taking. The end results are, of course, not yet so visible and striking, but the foundations of future development are being truly laid. The Hirakud Project, the Steel Plant at Rourkella, the Aluminium factory, the Delta Irrigation Project, the Ferromanganese factory, the Paper factory, National Foundry and Rolling Mills, sugar, textile and refractory brick plants, etc. etc., make an impressive list. It can be confidently expected that in another decade Orissa will be well on the way to rapid economic development. The development of a port in that State and modern inland navigation facilities will further accelerate the process.

The series of contributions published in this issue deal with the irrigation and power development project and problems of the State. They throw a flood of light on the emerging pattern of development. With the rich mineral resources of the State as yet untapped, Orissa can well vie with South Bihar and in time to come will add new industrial strength to the country as a whole.

An examination of river systems of Orissa will indicate that some of its problems are analogous to those of W. Bengal. Its deltaic streams require annual flushing with freshets of the monsoon waters. Now that the problem has been identified, let us hope that the necessary remedies will be quickly undertaken, as planned.

Orissa has one great advantage in that it has a higher percentage of forests than West Bengal. These are still relatively in better condition. With increasing industrialisation and extension of towns and with expanding agriculture, it is very likely that forests will have a bad time. But keeping in view the serious silt problem that Orissa's river systems face, it is of utmost importance that any integrated plan of development should include a significant part of the development of forests and soil conservation practices on a wide scale. We hope that Orissa's leaders will not, in their enthusisam for industrialisation, forget this natural asset which silently but significantly serves all plans of national progress.

One of the crucial deficiencies of Orissa is lack of general education among the population and the absence of technically qualified hands. As the present projects are under erection, full advantage should be taken to train the sons of the soil. In this connection we are glad to note that the first engineering college has recently been opened at Hirakud and the new generation of engineers are receiving valuable guidance. So much will depend upon these first batches of trained personnel. Their quality and their performance and their eagerness to learn and not merely to secure degrees will set the proper standard for the coming generations.

With the development of electricity and irrigation facilities, Orissa has opened before itself a vista of many-sided development. Now so much will depend upon the sagacious leadership of the State and of its people to enable them to take full advantage of the wide opportunities offered. Initiative, hard work and educated intelligence, all combined, will be richly rewarding.

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Our Delhi Letter

New techniques particularly in welding had to be introduced on the analogy of other countries. India would take advantage of the present Standards Conference to make a real improvement regarding steel.

Full employment through small industries

Shri Desai next mentioned the cottage and small scale industries. Large scale industries gave jobs to a few individuals. It was essential in the interest of full employment conditions in India that small industries may be encouraged. This can be done if there is standardisation of raw materials as well as of finished products. Any assistance in this direction from the Standards Organisation would be most welcome.

India has set its mind and energy to the completion of a great experiment in which without hatred or animosity towards any group or nation, she is to advance in her onward march towards uplifting of the standards of the common people. This is the touch-stone for its activities under the Plans. India's vast man power has a great challenge confronting it. It is hoped that tangible results will be produced by the labours of the vast multitudes of India under a wise leadership.

Indian Standards Institute has done valuable work

The readers of the Indian Journal of Power and River Valley Development will be happy to know that the Indian Standards Institute has made great progress in the collection of reliable data on standards. All engineering undertakings will be greatly assisted by making more extensive uses of the facilities that are available in this institute.

National Construction Corporation

The quality of raw materials and the standardisation of products are only the first steps to the standardisation of human material as referred to by the Prime Minister in his message. India's real difficulty today and tomorrow will not be so much in money or materials but in trained man-power. It is heartening to know in this connection that the long awaited proposal for the National Construction Corporation has, at long last, taken tangible shape. This corporation has been registered as a business organisation although it has an official set up. To start with, the provinces with smaller engineering cadres have expressed their willingness to utilize the services of this Corporation. But it has every chance of having a good start because of the large increase in the tempo of the Plan Projects. The increased demand by the people for the implementation of the projects of their region, is bound to create favourable conditions for the participation of the National Construction Corporation in some of the urgent works now pending before the country.

Plan Project Teams

The fact that the Chairmanship of the Corporation goes to Mr. Siva Sankar and Shree R. K. Gupta has been made General Manager augur well for the utilisation of the valuable experience and judgement of these chosen individuals.

The Planning Commission have made a programme for the intensive examination of some of the important River Valley Projects in the country. For this purpose teams of top level engineers are being constituted with a view to have on-the-spot study of the bottlenecks and difficulties that are standing in the the way of smooth and economical execution of the projects. It is hoped that in this manner the completion of the project will be expedited by resolving the difficulties in a most practical manner. These teams will have the role for active but detached participation in the solution of difficulties. Their experience and established reputation will ensure proper attention on the part of the project authorities. This idea has emerged as a result of careful and prolonged deliberations of the National Development Council working under the leadership of India's Home Minister. This step is in the right direction and cooperation of all concerned would be desirable to make it a success.

Continued from page 4

Delta Irrigation Project

which can be considered complementary to Hirakud, provides for a new irrigation of 6,71,183 acres and aims to increase the present annual cultivation from 2,71,000 acres to 18,67,000 acres with regulated flood distribution between the various estuaries of Mahanadi so as to properly protect the existing irrigation against risk of floods. In statistical language it envisages construction of 983 miles of new canals and distributaries, improvement of 1468 miles of old canals and distributaries, construction and improvement of 450 miles of embankments both new and old with several masonry works and a field system of water course. The total amount of earthwork required in the construction of new and old channels as welll as embankments is 210 crores of cft. or as much as a small bundh 2 ft. wide at the top and 3 ft. high encircling round the Globe at the Equator would require. Independently of Hirakud, it is estimated to give a net return of about 8% at the 10th year of its development.

(*Continued from page* 2)

Power Development in Orissa

mented with a view to make power available to all villages of over 2,000 population and also other villages with less population, which can be supplied from the nearby transmission lines or diesel or steam stations. Thus, besides providing the amenity of electricity, these schemes will also raise the standard of living in the villages, by making energy available for small cottage industries, and for processing agricultural products.

Investigation of Bhimkund and Tikerpara Schemes

It is seen that even after the execution of the Hirakud Second Stage, there is likely to be shortage of power in the State owing to increased demands for steel, ferro-manganese, alluminium and other subsidiary industries. In order to meet this situation, it has been decided to launch new projects. Accordingly this Investigation Scheme has been taken up with a provision of Rs. 12 lakhs to investigate and prepare Project Reports for new schemes.

Nationalisation of Private Electric Supply Cos.

Since it is observed by the State Government that the private Electric Supply Undertakings are not paying proper care and attention to development of their areas of supply in the national interest, it is proposed to acquire such of the Undertakings, in the first instance, which will give largest benefit to the public. A provision of Rs. 25 lakhs has been made in the Second Five Year Plan for this purpose and the question of enactment of necessary legislation is engaging the attention of the State Government.

Power from the various schemes will be utilised in industry and for lift irrigation. Some of the major industries utilising power are aluminium factory at Hirakud, steel factory at Raurkela, ferro-manganese plant at Joda and Rayagada, paper mills at Choudwar, Kesinga and Brajrajnagar, cement factory at Rajgangpur, collieries at Ib and Talcher areas, mining loads in Biramitrapur area, Hatibari and Panposh, Koira, Nuamondi of Bihar, refractory brick plant at Belpahar and Rampur, glass works, weaving mills etc, at Rairangpur, industrial loads in Choudwar area at Cuttack.

Power for railway electrification will be made available and the State Government have agreed to supply 5,000 kW. power to Bihar and when the Bhimkund Scheme is constructed we may give further power to the D.V.C. area in addition to supplying power for the second stage of aluminium and ferro-manganese factories and steel factory (including fertiliser factory).

Automatic Determination of Moisture

A series of electronic devices which will automatically perform vital routine analyses in the laboratory has been developed in the United Kingdom. The first instrument to reach commercial production is a meter for the automatic determination of moisture.,

Its electronic system is so arranged that it will also automatically carry out the titration of chemicals. This is the measurement of the amount of any given chemical on the basis of the quantity of it required to cause a chemical reaction with a standardized solution of another chemical. The reaction, or end-point, of such titration measurements is shown by the lighting-up of a pilot lamp.

The makers—Baird & Tatlock Ltd., London—claim that the results achieved are equal to good manual titration. Every instrument in the series is of a type normally found in the analytical laboratory, but all have been adapted to at least partial automation. The skilled operator is thus relieved for other work for at least some of the time he would otherwise have to spend on routine but highly skilled operations.

The firm claims that the instruments will also enable considerable laboratory analytical work to be done by an unskilled operator, since, in general, the more difficult part of the technique necessary has been made automatic through an electronic system of measurement and control.

This is but one example of recent engineering development in the United Kingdom. There are many others.

Chement-Handling Equipment

Now in production is equipment for automatically transporting cement from the site where it is mixed to the point where it is to be used. Pneumatically operated, the equipment will transport the mixed cement 1,000 ft horizontally and more than 100 ft vertically. It is claimed that it will convey up to 35 cu. yds per hour through a 6 inch pipeline.

The pressure cylinder, which will hold 17 cu. ft of cement, is located at the mixing point, and the cement poured into it through hopper at the top. Compressed air, stored in an air receiver, is then admitted to the top of the cylinder through a valve, and the cement is forced through the pipeline. Regulation of the air pressure in the cylinder governs the cement's speed of travel.

At the delivery end of the pipeline, a discharge box separates the cement and the air, and a central baffle within it divides the flow of cement into two streams which are re-united before the final delivery. Velocity is thus arrested and the force of discharge reduced. Pipeline is supplied in sections 10 ft. long and 1 ft, 2 ft, 3 ft, and 5 ft sections and bends are also available. Blaw Knox Ltd., London, manufactures the equipment.

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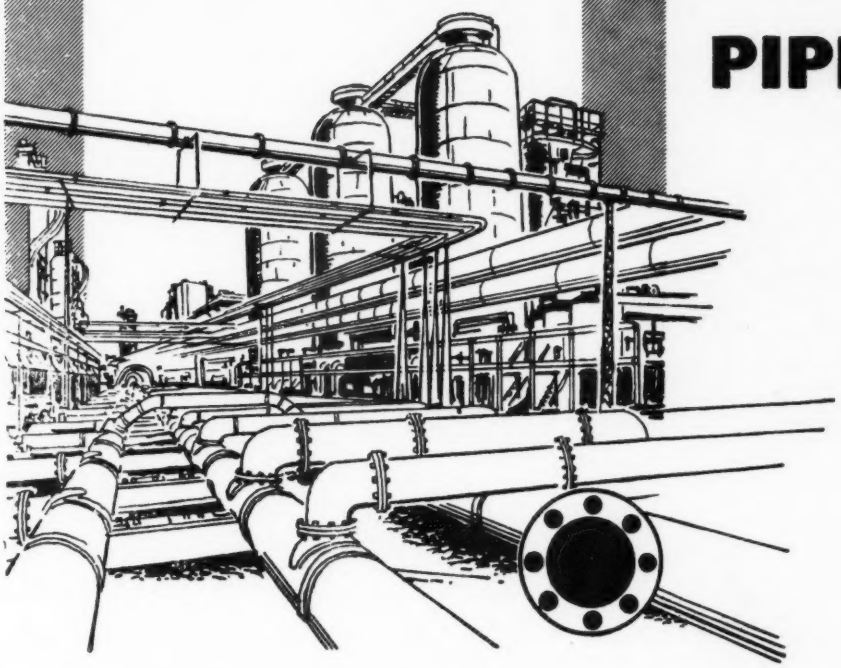

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